TEXTILE RESEARCH

Publication of Textile Research Institute, Inc., and The Textile Foundation

Reference Dept.

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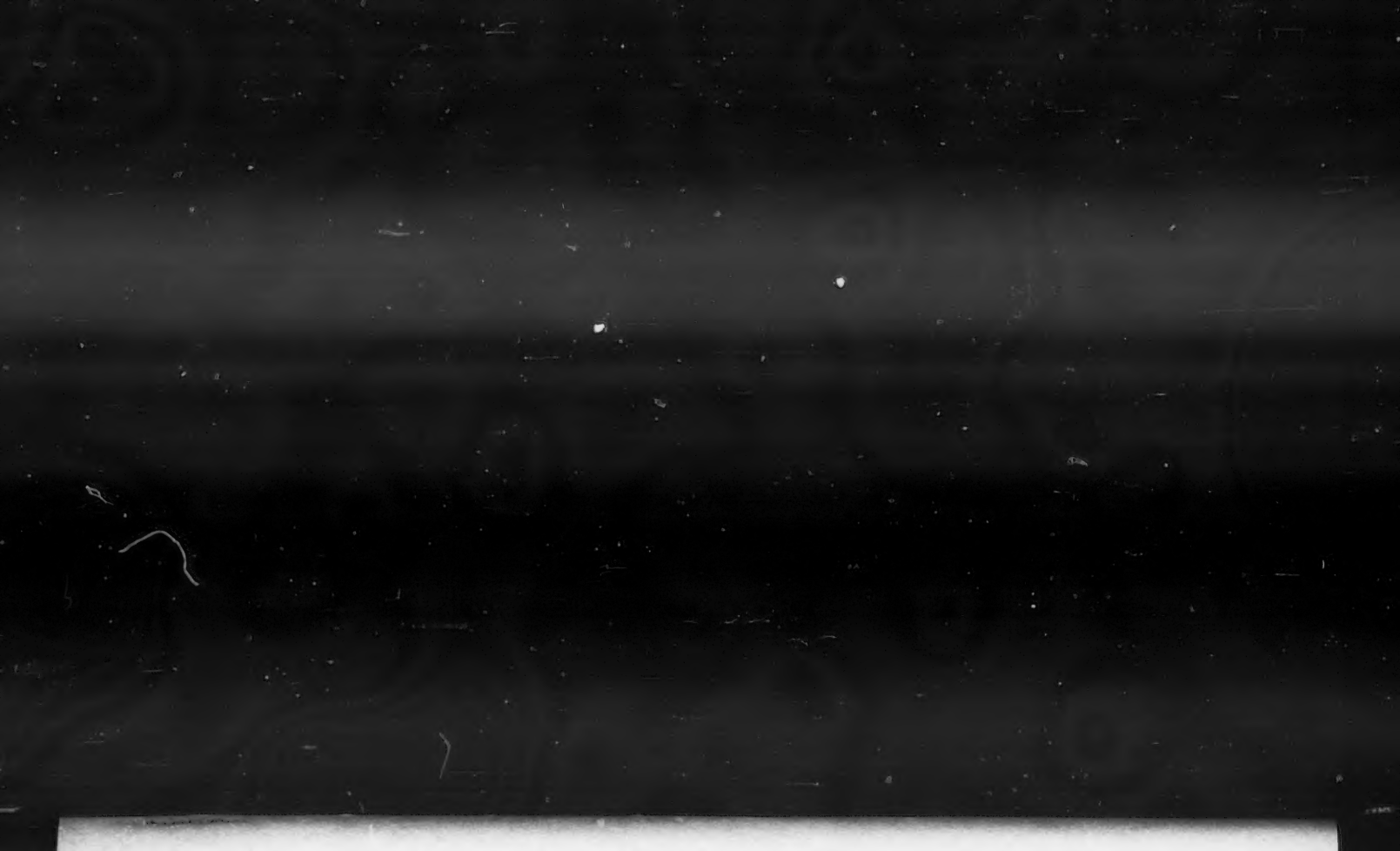

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In This Month's Issue

Annual Meeting of the Institute

Numerous requests have been received for the various papers which were presented at the annual meeting of the Institute held in New York, November 10. In this issue will be found a detailed reporting of the meeting. (See pages 394 to 420 inclusive.)

* * *

Fundamental Research

The fundamental research program of the Institute and the Textile Foundation, also some applications of fundamental research to the field of textiles are discussed. (See page 396.)

* * *

Applied Research

Progress reports on the Institute's program for applied research are given. (See pages 400–404.)

* * *

Economic Research Project

The Institute's project on the post-war competitive position of the textile industry is described. (See page 405.)

* * *

Address at Institution Luncheon

That the textile industry now stands on the threshold of many new developments and that in his opinion never has there been such an opportunity for a rebirth of the industry, is emphasized by Dr. Gustavus J. Esselen. (See page 410.)

* * *

The Moscrop Single Strand Tester

Use of the newest type of Moscop Tester for the determination of yarn strength is fully described. (See page 421.)

Reports of Projects Under Way On All Fronts Feature

T. R. I. Annual Meeting

This year's annual meeting of the Textile Research Institute, Inc., held November 10 at the Hotel Roosevelt, New York, marked a milestone in the Institute's affairs in that it was possible to report actual progress on all fronts of its program:

In the growth of an organization which has increased its annual membership income within a year from $25,000 to approximately $100,000—an increase of 300%, exclusive of additional income of nearly $40,000 for special projects—there are bound to be growing pains and a need to appraise the policies and progress with a view to constructive improvement.

To this end, the board appointed a special committee of five directors to survey the Institute's Activities and report its findings to the board as a whole, and then to a special meeting of members. Results of that survey will be reported in a later issue of TEXTILE RESEARCH.

Reports from All Fronts

At the morning session, reports on applied research projects under way were presented under the direction of W. D. Appel, chairman of the applied research committee, and Giles E. Hopkins, director of applied research. These projects include that on cotton carding, reported by Prof. Elliot Grover of North Carolina State College Textile School; that on warp sizing, reported by Prof. W. E. Shinn, also of North Carolina; and that on radiation drying, reported by Dr. Richard Wilhelm, of the Institute's staff at Princeton, N. J.

At the first session in the afternoon, a report on the economic research project under way was presented under the direction of Robert R. West, chairman of the economic research committee, and Douglas G. Woolf, director of economic research. Speakers included Dr. A. M. McIsaac, of the Department of Economics of Princeton University, who is heading up the project, and Dr. James G. Smith, also of the Princeton faculty, who is associated with Dr. McIsaac in the conduct of the project.

Concluding this session was a report by Dr. Frederick M. Feiker, chairman of a special committee on textile education appointed by the Textile Foundation and the Textile Research Institute, Inc.

The concluding session featured a report by Dr. Henry Eyring, professor of physical chemistry at Princeton University, and acting director of fundamental research for the Institute and the Foundation. In the absence of Dr. Robert E. Rose, chairman of the fundamental research committee, Dr. F. Bonnet, of the American Viscose Corp., presided at this session.

At the members' meeting, the treas-

At Institute luncheon, left to right: Fessenden S. Blanchard, president, T.R.I.; Colonel Bradley Dewey, president, Dewey and Almy Chemical Co.; Arthur Besse, president, Natl. Assoc. Wool Mfrs.

urer's report was submitted by Edward T. Pickard, and the president's address by Fessenden S. Blanchard.

Officers were re-elected as follows: Fessenden S. Blanchard, president and executive secretary; Douglas G. Woolf, first vice-president; Robert E. Rose, vice-president; Harold DeWitt Smith, vice-president; Edward T. Pickard, treasurer. New directors elected were: A. G. Ashcroft, of Alexander Smith & Sons Carpet Co., and J. E. Bassill, president, Tubize Rayon Corp.

The directors of the Textile Research Institute, Inc., now include: W. D. Appel, A. G. Ashcroft, John Bancroft, Jr., J. E. Bassill, Arthur Besse, Fessenden S. Blanchard, F. Bonnet, C. F. Broughton, Fuller E. Callaway, Jr., H. M. Chase, Earl Constantine, Russell T. Fisher, Ephraim Freedman, H. Grandage, M. Earl Heard, Marland C. Hobbs, Luther H. Hodges, Charles J. Huber, W. M. McLaurine, Louis A. Olney, Edward T. Pickard, D. H. Powers, Robert E. Rose, Edward R. Schwarz, Albert L. Scott, Harold DeWitt Smith, Charles A. Sweet, Albert C. Walker, Robert R. West, Douglas G. Woolf.

At the luncheon, Frank D. Cheney, director of the Textile Foundation, conveyed the greetings of that organization in the absence of Franklin W. Hobbs, chairman. The speaker at the luncheon was Dr. Gustavus J. Esselen, whose subject was: "The Textile Industry—Re-Birth or Second Childhood?"

Detailed reports of the sessions of the meeting will be found on the following pages.

Program of Textile Foundation and Textile Research Institute in

Fundamental Research

By HENRY EYRING Ph.D.*

Presented at Annual Meeting of Textile Research Institute, Inc.

In the fundamental research program, we expect eventually to have a permanent staff of about five mature scientists. Their interests will embrace as nearly as possible the entire textile field including pertinent aspects of physics, chemistry and biology. Besides their own research, they will direct the investigations of approximately a dozen graduate students. It is anticipated that in problems of mutual interest there will be fruitful exchanges of views between our staff and the staffs of Princeton University, the Rockefeller Institute for Medical Research and the RCA Research Laboratories.

Back of the Textile Research staff at all times is the small directing committee of experts who give their time and advice in the making of basic decisions. Dr. Rose, as chairman of this committee and as wise counselor, draws on a life-time of experience in directing a great research laboratory. His kindly advice is continuously solicited and received.

* Department of Chemistry, Princeton University.

Now, what may be said of the research program itself?

Stating the Problem

Each piece of cloth is woven from yarn. The yarn is made by the twisting together of fibers. The fibers are made from incompletely oriented and crystallized long polymeric molecules. These polymers are in turn formed from monomers each of which is made of atoms. The atoms in turn are made of electrons and nuclei. The nuclei now are turning out to be complicated little worlds in themselves. As if this were not bad enough, the textiles are dyed with different kinds of dyes, water-proofed, fire-proofed, insect-proofed, and in spite of all, eaten by the most diverse organisms. Textiles are put to a thousand uses and the fibers originate in an ever-increasing variety of ways—some natural some synthetic. One stops enumerating the complications rather from his own exhaustion than from exhaustion of the subject. In textiles this is the day of the stout-hearted pioneer. Success goes to imagination and to the courage that can cut its way through a largely uncordinated factual jungle.

However, even in things as complicated as a living organism there are always certain processes which limit the rate of change. These processes can be determined by observation of

At Institute luncheon, left to right: Dr. Henry Eyring, director of fundamental research for the Institute and for the Textile Foundation; Earl Constantine, president, Natl. Assoc. of Hosiery Mfrs.

the results of a systematic variation of such things as temperature, pressure and added compounds on the property of interest. The striking thing is that one generally finds some single factor is the critical one. Thus if a yarn made from natural fibers is insufficiently twisted it will break by the fibers simply pulling apart. Under such circumstances the strength of the fibers have nothing to do with yarn strength. On further twisting the fibers pull against each other with a force which prevents slip under tension. Fiber strength now becomes critical for the strength of the yarn and any further twist is to be avoided as it simply increases the stress on the fiber for a given stress on the yarn.

Theory of Deformation

It is therefore of very great interest to study the physical properties of individual fibers. The fundamental theory of all physical changes has been greatly developed in the last few years. Thus we come to this field of research with definite ideas or how data is to be interpreted. Deformation of a fiber occurs by atoms or molecules (or groups of atoms or molecules) slipping past each other. This is exactly what happens in any chemical reaction since in reactions atoms also give up old partners and acquire new ones. The rate, k′, with which any collection of atoms or molecules undergoes some change is the product of three factors: (1) an equilibrium constant, K, which expresses the chance that the system will be in the critical activated state; (2) the rate constant, kT/h, for such activated systems to react; (3) and finally the chance, kappa, that having reacted it will stay reacted. Now the only one of these factors one can do much about is the chance of the system being in the critical activated state.

Thus a stress applied to a fiber performs part of the work of shifting the system to the activated state and so lessens the amount of additional energy needed. Lessening the required additional energy increases exponentially the likelihood of the sys-

tem possessing the critical amount. With sufficient stress slipping thus becomes certain.

Enough has been said to indicate in a general way the nature of the mathematical theory of deformation which has occupied much of the author's time in the last few years. Careful measurements of rate of relaxation of strain at constant stress and of rate of relaxation of stress at constant strain will tell us exactly how many atoms let go at once in the slipping process. The strength of the bonds broken and therefore their nature can thereby be adduced. The nature of the mechanism by which moisture and other chemicals influence slipping can likewise be ascertained. Under some circumstances at high temperature oxygen cuts polymers in two—just as it does in rubber—and in this way relaxes the stress.

Experimental Investigation Started

Howard White, an Institute fellow, is beginning an experimental and theoretical investigation of the relaxation of stress at constant strain of natural cellulose fibers. This is to be done under carefully regulated humidity and temperature conditions. The ether linkage between glucose units in the cellulose chain has a strength of about 90,000 calories per mole whereas the hydrogen bond that one glucose makes with its neighbor is only about a ninth as strong. However, if ten or more glucose units in neighboring long chains lie next to each other in an orderly fashion the two chains may as a result be bonded together more strongly than are the ether linkages in the separate chains. Thus the cellulose fiber is pictured as being made up of linked glucose chains which in places are bound by hydrogen bonds to neighboring chains. The chain passes through regions of disorder also only to find further along still that it has again entered another region of orderly superposition which binds it to new chains. Thus cellulose is very much like rubber in being composed of chains in a disordered state but connected at intervals by secondary bonds to form an interlocking network. Because the cellulose chains have less tendency to curl up cotton stretches less than rubber when pulled. This picture of fibers being composed of long chains joined by secondary bonds is apparently a general one for fibers and stress and strain relaxation experiments are extremely revealing for all fibers.

The fact that textiles can take a set in the usual pressing processes and that they can be made to swell and dissolve with a variety of reagents all help to fill out this picture of secondary bonds which break under relatively mild treatment. Controlling these properties more intelligently is the key to success in several great industries and a better understanding of fundamentals will play its part in this control.

Other research will be directed toward studying the effect of chemical treatment on natural and artificial fibers. Thus, in earlier work of the Foundation, marked changes in the properties of wool were found by introducing hydrocarbon chains in between the sulfur atoms in cystine. A representative of one of the great industrial research laboratories said this published research had been of very considerable service to them. The

plan is to study these promising leads further and to extend them to other fibers. In all such cases we shall be as much interested in the mechanism by which changed properties are brought about as in the changed properties themselves, because such understanding will bring nearer the day when these changes can be brought about systematically according to a preconceived plan.

Study of Dyeing Mechanism

We also plan to continue and to extend the studies on the mechanism of dyeing. This occurs in many cases by the anion of the dye adding by electrostatic attractions to such positive charged groups as substituted ammonium nitrogens in proteins. Such things as Glauber's salt and naphthalene sulfonic acid provide negative groups which compete with the dye for the positive group on the fiber. This latter effect may in certain cases more than offset the effect of added acid which increases the attracting positive charges on wool. The valuable work of Steinhardt in this field provides a useful beginning on which to build.

Another realm in dye chemistry in which the fundamental approach will be particularly valuable is in the systematic study of what makes a dye and how added substituents may lead to a desired color and to the ability to stain a fiber. This is a field in which we intend to bring into play the latest advances in both theory and experiment. In the dye field Dr. Rose has agreed to take an active part in directing research.

Artificial fibers are prepared by controlled polymerization or condensation while in the natural fibers nature uses its own methods. It would indeed be surprising if with our limited staff we could successfully compete with the great industrial research laboratories in their program of preparing new tailor-made fibers. However, there is the fundamental field of developing better methods for determining the lengths and distribution of lengths of polymers by osmotic pressure, viscosity or other measurements where our type of laboratory has a definite advantage. This is because we, like the universities, are not under the same type of economic pressure to produce a commercially valuable product.

As personnel becomes available we will increase our knowledge of the methods and of the mechanisms of water-proofing, fire-proofing and prevention of biological deterioration. Our difficulty, of course, is not to find enough problems but rather to choose those we can attack best with our limited personnel.

This fundamental research program is going to help the smaller textile firms who are unable to maintain a comparable staff by making available to them research information which they would not otherwise have. And in so far as it contributes to the development of new outlets for textiles the help is even more direct.

More significant in the long run will be the skilled graduates whose return to the industry will increase that highly trained personnel which we may hope at least will aid all of us in leavening the whole industry.

Progress Report on Institute's Applied Research Project on

Radiant Drying

By R. H. WILHELM Ph.D.*

Abstract of Progress Report Presented at Annual Meeting of Textile Research Institute, Inc.

The objective of this project is a study of the physical principles in radiant drying and procurement of basic engineering data. Progress to date has been of a preliminary and orientation nature. Results and conclusions presented in this early report are subject to further verification and amplification in the continuing project.

Studies were presented on drying of ¼ inch woven wool felt and of absorbent cotton. These materials were selected because they represent different types of thick textile materials, one soft, the other semi-rigid. The course of radiant drying was studied in each case from a condition of saturation wetness to one of complete dryness. Drying rates and temperature changes were measured and the results were analyzed in the light of probable drying mechanisms. The beginnings were made in an experimental study of the optical penetration of radiant heat into textile materials during drying with a view to evaluating its importance.

The following three conclusions have been reached on the basis of the work to date:

1. The course of drying was found to be closely similar in radiant and air-convection drying. In each, two major periods are clearly distinguishable on a rate-regain diagram. In the first period, free water capable of being centrifuged from the material, is dried at a relatively rapid rate, and in the latter, water held in the fibers is removed by a slower, diffusion mechanism. As was expected, the rate of radiant drying was greater than convection air drying in each period. A theoretical equation was developed for a heat balance and for the rate of radiant-heat drying of textiles in the free-water period. The variables included were the intensity of radiant flux, reflectivity of the sample surface, latent heat of vaporization, heat and mass transfer coefficients, and the temperatures and water partial pressures of the surface and of the air in contact with the surface.

2. It was found experimentally, and was checked theoretically, that a stream of air at room temperature passed over material being dried by radiant heat does not materially decrease the rate of drying but *does* lower the temperature of the work to a significant extent. Implications of this finding in the temperature control of heat-sensitive material were

* Of Applied Research Laboratory, Textile Research Institute, Princeton, N. J. Work done by Dr. Wilhelm and Dr. G. T. Paul.

At Institute luncheon, left to right: W. D. Appel, chairman, applied research committee, T.R.I.; Dr. Richard Wilhelm, Institute's applied research laboratory, Princeton, N. J.; Prof. Elliot B. Grover, N. C. State College Textile School.

mentioned. An example of this effect was given in the drying of absorbent cotton. Air at 78° F was blown over the sample at velocities ranging from 2.5 to 13 feet per second. In this interval the surface temperature changed from 130° F to 99° F but the drying rate decreased only 4%. It may be stated that when heating is the objective, as in the curing of resin coatings, cooling air streams are objectionable; in radiant drying they may be beneficial.

3. Through sample temperature measurements during radiant drying and through independent penetration studies with an optical bench and thermopile, strong evidence has been gathered that radiant energy may penetrate a considerable distance into thick textile materials. The direct result is a rise in the temperature of the center of the material above the surface temperature. For example, in ¼" wool felt a temperature difference of 14° F was detected during drying. After drying had been completed and the sample was held in the same position between the lamp banks, the differential between center and surface temperature rose to 54° F. A heat balance equation for this effect has been developed. It relates the temperature at any given distance from the surface with the surface temperature, the radiant flux density, the radiation absorption coefficient for the material, and its thermal conductivity. The study of this effect and its possible importance will be continued.

Summary of Some Results Obtained From Institute's

Warp Sizing Research

By WILLIAM E. SHINN*

Summary of Report Presented at Annual Meeting of Textile Research Institute, Inc.

The introduction of synthetic staple fiber in the textile mills created new problems in processing methods. Outstanding among these was warp sizing. It was generally recognized that starch films were not too adherent to viscose filaments and less so to acetate filaments. On the other hand the similarity of the new staple yarns to cotton yarns suggested the application of starch and other sizing agents already in use for cotton. The situation was complicated by the wide variety of sizing machinery available in the mills. Finishers of rayon staple fabrics reported difficulty in some cases in obtaining complete removal of the sizes. Difficulties in obtaining level shades in dyeing were sometimes attributed to the presence of small portions of residual sizing materials.

In the manufacture of cotton goods the practice of kier-boiling grey goods preparatory to bleaching and finishing had in many cases been relied upon for elimination of the sizing materials. Since this processing was not adaptable or even desired for synthetics there was the temptation to reduce costs by quick, inexpensive methods of removal.

A program of warp sizing research was undertaken by the Textile Research Institute, the objective of the program being the solution of some of the problems facing the industry. The experimental work was conducted

* Professor, North Carolina State College Textile School.

At Institute luncheon, left to right: Giles E. Hopkins, director of applied research, T.R.I.; Prof. W. E. Shinn, N. C. State College Textile School.

at the laboratories of the Textile School, North Carolina State College and covered the period from October, 1940 through November, 1942.

Some of the problems studied were as follows: (1) Adhesion. To determine whether starches and other well-established adhesives have sufficient adhesive power for successful warp sizing and weaving of rayon staple yarns, also the best types of converted starches; (2) to determine the causes underlying loss of surface fiber in the loom and how shedding may be reduced or eliminated; (3) to determine which sizing agents will furnish the necessary protection against chafing and still come off easily in finishing, also whether enzyme removal is necessary and causes harshness in the goods.

In addition to the above, detailed studies were carried out (1) on the effect of stretch and slashing, both on the tensile strength and elongation of yarn and on weaving and dyeing; (2) abrasion resistance; (3) cloth stiffness; (4) cloth desizing and dyeing.

(Complete report of some of the phases of this study which are of especial interest will be published in forthcoming issues of TEXTILE RESEARCH. Editor.)

Preliminary Report on Institute's Applied Research Project on

Cotton Carding

By ELLIOT B. GROVER*

Abstract of Progress Report Presented at Annual Meeting of Textile Research Institute, Inc.

Tentative conclusions and observations reached to date, include the following: (1) Considerable increases in card production per unit are feasible without detrimental effects on the quality of the product; (2) yarn strengths are not impaired significantly as a result of increased card speeds; (3) yarn character or appearance is affected only to a moderate degree by increases in card speeds; (4) neppiness is affected more by the condition of the raw material than by changes within the card; (5) high fiber strength cotton will result in good running work and high strength yarn; (6) fiber strengths are not impaired by increased card speeds; (7) average fiber lengths by weight remain unchanged over wide ranges of card speeds; (8) waste removal can be controlled at least to a limited extent to allow high production without serious deterioration in the quality of the product; (9) peak power demand charges are not increased by the use of high over-all card speeds; (10) further investigation is needed and will be made on the effect of front knife plate settings.

* Professor, North Carolina State College Textile School.

Report on the Projects Now Under Way or Being Considered in

Applied Research

By GILES E. HOPKINS*

Presented at Annual Meeting of Textile Research Institute, Inc.

In a report covering the first year of the director's association with the Institute, Giles E. Hopkins reviewed the applied research program and gave a brief outline of the projects now under way. These include:

1. The Carding Project (conducted at the Textile School, North Carolina State College). Under this program the various moving parts of cotton cards would be speeded up to determine the effect of such speed changes, and combinations of speeds, on the quality of the resulting yarn, the yield, and the power consumption. An outline of the tentative conclusions and observations reached to date is given elsewhere in this issue.

2. Drying by radiation. An outline of this project was given in the November issue of TEXTILE RESEARCH and an abstract of a progress report by Dr. R. H. Wilhelm appears elsewhere in this issue.

3. Moisture Equilibria in Textile Fibers. Mr. Hopkins stated "Doctor Walker, of the applied research committee, has rendered a valuable service to the Institute and the industry through an exhaustive study of the drying data obtained by Wiegerink in the investigation of textile drying which was carried out by the Institute some years ago. Doctor Walker's calculations have been turned over to the applied research staff for further check and verification, and we have under consideration the preparation of a report showing extrapolations and interpretations of the Wiegerink data in conjunction with other published material.

4. Varnished Insulation. "We have entered into a contract to conduct a study for the Varnished Fabric and Paper Division of the National Electrical Manufacturers Association. This study will be directed toward improvement of the electrical characteristics of varnished insulation.

5. Warp Sizing. "A summary of the work on warp sizing of spun rayon yarns is being prepared. This work is based on the individual reports which have already been supplied to the sponsors of this special work and will form a final compilation of the most important conclusions. We are preparing for publication papers covering certain well integrated sections of the work completed prior to 1943."

A number of additional specially sponsored projects have been suggested and are under consideration.

* Director, Applied Research, Textile Research Institute, Inc.

Post-War Competitive Status of Textile Industry to Be Subject of Institute's

Economic Research Project

By A. M. McISAAC Ph.D.*

Presented at Annual Meeting of Textile Research Institute, Inc.

I want to express my appreciation of the opportunity to be present at this meeting and to participate in the discussion of the Institute's program of economic research, focusing on the post-war competitive position of the textile industry.

In initiating this project your economic research committee was animated by the conviction that, as the period of post-war readjustment approaches, there is need for a broad-gauged appraisal of the problems and situations that will confront the textile industry in such a period. Hindsight evaluation of the experience following the first world war suggests that perhaps some of the grief of that period might have been avoided had there been a general awareness of the over-all situation confronting the industry. This time, to be sure, we have no lack of concern with the problems of post-war readjustment, and of the multiplication of plans and proposals there is virtually no end. However, without indulging too deeply in the hazardous art of prophecy, it seems worth while to try to assemble and present in a systematic way the best information that can be had regarding the conditions that are likely to govern the course of the post-war readjustment and to influence the position of the industry for some years to come.

Organization of the Project

The execution of the project, within the broad outlines laid down by your research committee, has been entrusted to a research group under the direction of an executive committee of which I am serving as chairman, with the assistance of Professor J. G. Smith of Princeton, and with Douglas G. Woolf of the Institute as our administrative officer. Active research on different phases is or will be undertaken by competent economists, including members of the executive committee and others drawn from the staff at Princeton and elsewhere in accordance with the requirements of the project for staffing.

We expect to maintain a close liaison between the work of the various staff members and the members of the Institute's committee on economic research. It goes without saying that in carrying through the project it will be necessary for us many times to appeal to you, in the industry, for information and advice, but we shall make it a practice to have all such requests for assistance routed through Douglas

* Department of Economics, Princeton University.

Woolf and the Institute. In addition to the economic research committee of the Institute we have been able to enlist the cooperation of an advisory committee including members of the department of economics and of the school of engineering at Princeton, to whom we can turn for advice and suggestions either in planning the project or in interpretation of results.

Outline of the Project

The general outlines of the project have already been indicated in the press releases of the Institute, but I will endeavor to fill in the skeleton outline of the project in a little more detail. As we have set the project up it is divided into three sections or phases. The first phase is an introductory or preliminary survey of the present position and roblems of the textile industry. The second phase is the preparation of a group of studies of special problems that appear to warrant particular and more detailed investigation. Although I have spoken of this as a second phase, the investigation of at least the more urgent problems will be carried on concurrently with the preliminary survey. Indeed we regard the preliminary survey largely as a first fruit or by-product—a progress report if you like—based largely upon the initial work on the larger and longer-range studies included in phase two. The third phase will be the preparation of a final summarizing and integrating report or series of reports.

In the preliminary survey we shall seek to place in general perspective the effects of the war on the position of the textile industry and its several branches, and to indicate the factors that are likely to exert a significant influence on the post-war situation. This will call for a consideration of the distortions of production and markets resulting from the war, the forces affecting the demands for textiles as a group of allied products, and more particularly the forces tending to affect particular groups of textiles. It will involve also an examination of the conditions affecting the supply of American and foreign textiles, actual or potential, including questions of labor and material supplies and costs, conditions of production, marketing methods and costs, and so on.

I need scarcely say that we are not deluded into thinking that we can provide answers to all the questions that I have raised, either in the preliminary survey or in the final report. The principal purpose of the preliminary survey, as I have already indicated, is to stake out the ground that we propose to cover, to bring together the issues that require more extensive investigation, and, we hope, to provoke further discussion within the industry on those questions that have a significant bearing on business policy.

A major part of the work on the project will be devoted to a series of special studies of particular problems of the industry that we have referred to as phase two of the project. Although the list of topics to be taken up for detailed investigation has thus far been drawn in a somewhat tentative way only, and is subject to modification as the project develops, the following topics now scheduled will serve to indicate the general approach and the range that we hope to cover. It is expected that each of those listed will be carried through as a separate study, although they are all closely interrelated, and the inter-relationships

At Institute luncheon, left to right: Douglas G. Woolf, first vice president, T.R.I.; Dr. A. M. McIsaac, economic research committee; Robert West, chairman, economic research committee.

will be kept carefully in mind so as to secure an integration of the completed studies. I should add that the subjects listed below were arrived at as a result of considerable discussion with members of your economic research committee. They obviously vary considerably in complexity and magnitude, and with the current shortage of manpower in the research field, as elsewhere, it has not been possible for us to inaugurate all of them in the beginning.

Topics of Special Studies

Among the subjects for detailed study we have listed the following:

1. The demand for textiles (both in general and for specific types of products). This is undoubtedly the largest, and at the same time least tractable, of the questions that arise with respect to the post-war era, both because of the multiplicity of textile products and outlets, and because of the manifold forces affecting consumers' incomes and behavior. It is nevertheless generally agreed that we need to try to bring together and to evaluate the available data, so that when we are forced to estimate the probabilities of the future our estimates will at least be somewhat more informed.
2. Foreign textile industries and markets (including analysis of the competitive relations of American and foreign producers.) This again is an area for which much pertinent information is lacking, and critical questions of international commercial policy are involved. Again, however, it seems worth while to undertake the assembly of

the available data, and evaluation of the potentialities of the various possible lines of action.

Several topics may be roughly grouped together, as bearing on the cost conditions affecting textile production. Among these are:

3. Textile labor (including questions of labor supplies, organization, and costs).
4. Textile materials, costs, trends, and future prospects.
5. Textile production, manufacturing methods, organization, and costs.
6. Textile financing.

Still other topics group around the problems of industrial organization, marketing, and distribution; for example:

7. Industrial structure and organization (tendencies toward or away from horizontal or vertical integration, reorganization, etc.)
8. Textile markets and distribution.
9. Textile prices and price policy.
10. Industrial migration.

Thus far it has seemed desirable to give top priority to the studies of demand conditions, material supplies, and labor, although we hope to initiate work on some of the others in the very near future, and we are carrying on some preliminary investigations across the entire front, in connection with the preliminary survey.

Summation and Synthesis

What we have referred to as phase three of the project, or *final report*, might perhaps more appropriately be referred to as *summation and synthesis*. It is our belief that if the special studies already described are to be of the maximum service the points of major significance in each should be abstracted, and brought together in such a way that the interrelationships of the various analyses can be clearly seen. By a final report we do not mean to suggest another bulky tome to gather dust without being read, but rather a series of brief, high-spot pamphlets that will serve to put the spotlight on the salient facts, so that even he who runs may read! We are all, I think, intensely conscious of the importance of translating the results of economic research into those terms and forms in which it will be of the greatest possible use to the industry.

Relation of Project to Other Research

It is evident that what we are attempting to do is not intended to duplicate or substitute for the activities of such agencies. It will not be possible for us, for example, to attempt the collection of basic data for the various branches of the industry, or to deal with the intimately detailed problems of those branches. The function that we can usefully perform in the field of economic research is to concentrate on the task of drawing together the data available from existing agencies and sources, filling in gaps wherever necessary and possible, so as to achieve an integrated analysis of the position of the industry as a whole. It seems altogther appropriate that the Textile Research Institute, cutting across and representative of all sections of the industry, should promote research of this type.

Frank D. Cheney Brings To Institute Greetings of

Textile Foundation

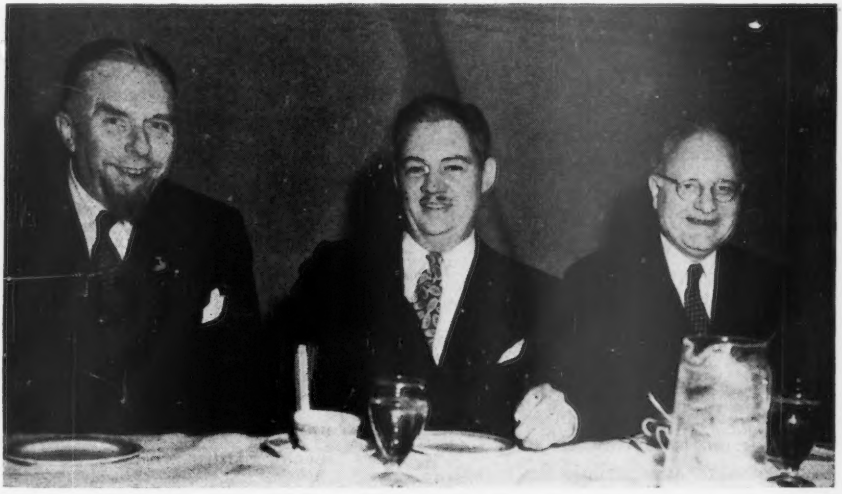
Abstract of Paper Presented at Annual Meeting of Textile Research Institute, Inc.

In the absence of Franklin W. Hobbs, chairman of the Textile Foundation, Frank D. Cheney, one of the directors of the Foundation, brought its greetings to the members of the Textile Research Institute, Inc., as follows:

"I am afraid I am a very poor substitute for Mr. Hobbs, but I am sure that I speak for him and for the other members of the Board of the Textile Foundation when I say to you how pleased I know they would be if they could be here and see in this meeting evidence of the growing interest in research in the textile industry.

"We are very happy to be associated with your Institute, the Textile Research Institute, through the cooperation of our fundamental research, and for the correlation to some degree of our fundamental research with your applied research, which is under the direction of Mr. Hopkins.

"I am not going to make a speech. I just bring to you the greetings of the Textile Foundation and from them their most sincere wish for your great success in the work that you have undertaken.



At Institute luncheon, left to right: Harold DeWitt Smith, vice president, T.R.I.; Malcolm E. Campbell, dean, N. C. State College Textile School; Ely C. Hutchinson, chief, Industrial and Consumer Products Branch, O.P.R.D. War Production Board.

The Textile Industry— Rebirth or Second Childhood?

By GUSTAVUS J. ESSELEN, Ph.D.

Abstract of Paper Presented at Annual Meeting of Textile Research Institute, Inc.

The advent of synthetic fibers into the textile industry illustrates very well what I mean by the phrase "re-birth or second childhood?" When artificial silk, as it was known at that time, first appeared in the textile industry in this country about 1908 or 1909, the official association of the silk manufacturers appointed a committee to consider the future of this new fiber and its possible effect as a competitor of natural silk. After numerous meetings and much deliberation it was decided that these new fibers would never amount to much and that the silk industry could proceed quietly on its way and ignore them. Many years later, the chairman of this committee told me that he had never been so wrong before or since. At the time it was certainly an illustration of second childhood—the point of view that what is at present and what has been done in the past are the best and permit of no improvement. Actually, of course, the advent of synthetic fibers has resulted in an outstanding period of rebirth in the textile industry.

* President, Gustavus J. Esselen, Inc.

It is commonplace these days to remark that all industry has been markedly affected by the war. In no industry is this more true than in the textile industry where the war has been the stimulus for the design or the engineering, if you will, of new fabrics for particular uses. A colonel in the Quartermaster Corps recently remarked in a public address that at the beginning of this war so far as clothing was concerned the United States Army was probably the best equipped in the world for fighting a war in Maine in the summer time and Florida in the winter time. Now, thanks to combining imagineering with textile engineering, our Army has the best fabrics in the world regardless of where it may have to go. In developing these special fabrics not only has all the skill of the textile engineer been employed but the chemists have contributed special treatments and special finishes and coatings, and the plastics engineer has provided new materials with which to work.

Progress in Other Industries

The alert textile organization today is keeping a weather eye not merely on new developments within its own borders but is also keeping abreast of progress in related industries. Some of these developments will offer compe-

tition while others will offer facilities to be taken advantage of in the textile industry proper. Take, for example, the paper industry. Paper products, such as bobbins and tubes have materially improved yarn packaging. On the other hand such items as paper bed sheets, paper pillow cases, paper draperies, and paper towels and napkins have entered a field which was hitherto the sole domain of the textile industry.

The plastics industry also offers both a threat and a promise. The threat lies in the relatively simple processes which can be used for extruding thin films for use as rainproof apparel or as windproof interlining, to mention only two of many possibilities. The promise, on the other hand, lies in such things as an entirely new market for fabrics for laminating purposes; procedures for greatly simplifying the production of finished webs without the use of elaborate weaving machinery; and the multitude of new surface coatings which the plastics industry makes available for the development of new fabrics and new types of fabrics.

The importance of mechanical techniques has long been recognized in the textile industry. In fact it was the introduction of power machinery which gave the textile industry its first rebirth and even after 150 years or more, improvements in the mechanics of the industry are still being made. For example, the latest model looms are reported to produce 40 percent more cloth per hour than an earlier model now in common use for weaving similar goods; and the end of increased speed of output is apparently not yet in sight.

Gustavus J. Esselen.

Emphasis on Chemistry

It is, however, from the application of chemistry that the textile industry can probably look for the greatest improvement in the next ten or twenty years. The emphasis in the past has been largely on mechanical research and the development of improved machinery. With the possible exception of bleaching and dyeing the textile industry has largely overlooked the fact that it deals with raw materials which are chemically reactive and capable of changes in characteristics by chemical means. While the effect of caustic soda in mercerizing cotton is probably largely physical and only to a small extent chemical, the chlorination of wool on the other hand to reduce its shrinking tendencies when washed, probably changes the wool chemically to a certain extent. The action of formaldehyde in preventing the crushing of rayon pile fabrics is

the result of chemical action. Similarly, the waterproofing of cotton or rayon fabrics by surface esterification is a chemical means to an improved physical property.

Combination of thermoplastic materials with textile fibers gives promise not only of the development of new and valuable fabrics but also of revolutionizing the methods of producing them. There are, for example, several types of bonded-fiber webs. None of these depend upon the usual processes of weaving for their stability. In some, the individual fibers are bonded by means of chemical action; in others the bonding action is supplied by extraneous adhesives; and in still a third type, the bonding action is contributed by the use of thermoplastic fibers. The principle in a modified form has been for some time applied in the manufacture of carpets where the pile threads were locked in place by means of an adhesive used here in combination with a weaving operation. In its latest applications, however, no weaving is involved.

This application of plastics permits the production of fabrics all the way from those which, on the one extreme are porous and permeable to moisture vapor but still non-wiltable; to impermeable waterproof rain apparel on the other extreme.

Chemical treatments are now available either to make fabrics crease resistant or to maintain the crease, as may be desired. Fabrics which may be dried quickly after laundering and require no ironing are attracting increasing interest. Processes are available for making fibers, yarns, and fabrics resistant to fire, water, and insects as well as to mildew and decay. The matter of treating fabrics, particularly cotton, wool and viscose rayon fabrics so as to render them resistant to mildew and decay, is one which cannot be overlooked by those mills which plan to sell their output in tropical regions after the war. Methods are known for doing this and your competitors will do it even if you do not.

In connection with fabrics for tropical regions, there is practically an unexplored field in the selection of dyestuffs. In many cases it is possible to select two dyestuffs which will give practically the same color shade even in the darker colors, one of which will absorb heat to a much greater degree than the other.

At the risk of appearing impractical, I would like to mention another tool which, if properly used, can often make the difference between a profit or a loss, particularly where competition is keen. I refer to the application of mathematics to the textile industry, particularly the methods of statistical analysis. This may seem highly academic to a mill executive but I can assure you that when properly applied and interpreted, this technique can be made to pay dividends. For example, it is obviously essential that your fabrics meet specifications yet there is no need to make them nearly good enough to meet Grade A merely to be certain that they pass Grade B. Statistical analysis will tell you when your product is good enough to pass the necessary requirements and if there are any deficiencies in the early production it can be used to determine their cause. Simply stated, statistical analysis is a mathematical method for studying the fluctuations in the quality of a prod-

uct, and the results of such statistical analysis permit the maintenance of control at any desired level.

The instances which I have cited are only a few of many which will occur to all of you illustrating the fact that we are on the threshold of many new developments which, if properly received and utilized, should result in a period of rebirth for the textile industry which has never been approached before. The question is what are the most effective steps to insure these advances to which all progressive managements are looking forward? This as it always has been is a problem of enlightened management with a youthful outlook.

The Research Movement

It seems to me that the first step toward insuring this new period of rebirth has been taken with the establishment of the Textile Research Institute. This demonstrates the growing appreciation that since the textile industry is really a single industry with many problems common to its several subdivisions, much can be gained by cooperation.

There will still be, however, and it is healthy that there should be, competition between individual mills. While a cooperative research program carried on by the Textile Research Institute will yield much valuable information, the progress of any particular mill will still depend upon how promptly and with what imagination and resourcefulness it applies this information in its own operations. In other words, the first step is to support cooperative research; the second step is either to establish a research and development division in your own mill or group of mills, or to obtain the same results through a consulting organization which can provide the services of a well-rounded experienced research group. Consulting organizations should also not be overlooked even by those who can afford their own research departments because the consulting organization can provide the added and very important factor of coordination of information and progress from related fields which may be competitive on the one hand but offer few markets on the other.

Management must be sure not to expect results to come immediately like the rabbit out of the hat. I have in mind, for example, a research program which was supported for six years through several periods of discouragement. However, the first year of production by the new process which was the outcome of all this work, resulted in well over $1,000,000 in new business in the first year and at a very much lower manufacturing cost than had ever previously been supposed possible.

Another point to remember is that research when once started should be a permanent program. The effect is lost if it is discontinued. I have known of an instance when a valuable new product was developed and the firm said, "Fine, we can now discontinue our research." In three years their competitors were ahead of them.

Some one has wisely remarked that the one certain thing in life is change. Never before, in my opinion, has there been such an opportunity as now for a rebirth of the textile industry.

Frederick M. Feiker Presents Report of Institute's and Foundation's

Educational Committee

By Dr. FREDERICK M. FEIKER*

Abstract of Paper Presented at Annual Meeting of Textile Research Institute, Inc.

During the session on economic research, a report was presented for the educational committee of the Textile Research Institute and the Textile Foundation, by the chairman of the committee, Dr. Frederick M. Feiker, dean of engineering at George Washington University.

Dr. Feiker spoke of the army training program, whereby thousands of young men have been trained in specialized courses, largely in the technical field, during the last three or four years. He emphasized the fact that this work has not been education, but training—and that it has been training for specific jobs. He pointed out that this emphasis on specialized training will have its impact on the future of all education and that consequently those interested in the promotion of technical education have the problem of taking out of this mass of educational procedures developed during the war, those things which can be applied to hasten the education of young men and also to develop them educationally to achieve a fuller life.

What Are Textile Schools Doing?

Coming to the part which textile schools are playing in this picture, Dr. Feiker pointed out that the textile industry is facing competition for trained men. Many of the young men coming back will be attracted by the glamor of other industries—the aeronautical field, the plastics field, etc. Maybe they aren't going to be interested in going to the textile industry. What can we do to stimulate their interest?

He spoke of two undertakings, specifically, of the textile school deans. First, the National Council of Textile School Deans went to Washington and discussed with the Veterans' Administration the administration of appropriations for education for returning service men. As a result, 5,000 copies of a pamphlet describing the field of the textile industry, and the kinds of jobs in it, were distributed by the Veterans' Administration to their 52 offices. It is believed that this was the only group of educators who attempted to do this for an industry. Carrying this further, there was on the press, at the time Dr. Feiker spoke, a 12-page pamphlet describing in more detail the kinds of jobs in the textile industry.

* Dean, Engineering School, George Washington University.

At Institute luncheon, left to right: Major D. B. MacMaster, director, research fund, T.R.I.; Edward T. Pickard, treasurer, T.R.I.; Dr. Frederick M. Feiker, dean, Engineering School, George Washington University.

Next, is the problem which both the textile field and the general field have: the problem of selection. Probably thousands of the 11,000,000 men in the services are going to take advantage of the offer of a free education. It means that there has to be devised a preliminary year of work to try men out to see if they may go ahead. Then, the educational programs must be modified to meet these special training needs.

Findings of the Committee

Among the findings of the educational committee of the Institute and the Foundation, the speaker pointed out, was that people in general have very little knowledge of the textile industry as compared with other industries—and yet it is a dramatic industry with a definite appeal because of its consumer contact.

Out of the inquiry was developed the idea of applying the army plan of training by establishing seminars for teachers of economics in all kinds of institutions where, in the summertime, they would get together for two weeks to study the problems of the textile industry. Also, there has been progress made in bringing to the textile schools, teachers of home economics for short courses.

In the long view, Dr. Feiker feels, the textile industry has a challenge from the point of view of competition for personnel. The fast-growing consciousness that the future of this industry, as with all industries, rests on a research viewpoint, that the rule of thumb has passed—not only in the field of raw materials, but in production, sales, and personnel problems—presents a challenge to industrial statesmanship that is second to none.

Survey of the Institute's Progress As a Whole Reported in

President's Address

By FESSENDEN S. BLANCHARD*

Abstract of Report Presented at Annual Meeting of Textile Research Institute, Inc.

My task now is to look at our situation as a whole, review briefly where we have come in the past year and where we are going. After final decision by the directors in February on the present broad-gauged policies of the Institute and on the basis of membership, the membership campaign got under way about the middle of March—beginning with the organization of a research fund committee under the chairmanship of Albert L. Scott. Since the campaign started we have averaged signing up one company every business day. Here are a few figures:

	Nov. 13, 1943 at $100.	Nov. 10, 1944 $100. to $1500.
Number of company members	125	162
Number of individual members (at $10.)	281	352
Annual income from company and individual members	$15,310.	$84,120.
Membership income, including Sustaining membership	$25,310.	$94,120.

The above includes 83 old members who have accepted the new basis of membership and 79 new members. In addition we have 33 companies whose memberships on the old basis have either recently expired or will expire by the first of the year, whose final decision on the new basis we have not yet heard. I am very hopeful that we shall reach $100,000 from memberships by the first of the year.

I should make clear, as already announced, that the Textile Foundation has voted to move its fundamental research into the Institute's Princeton property as soon as the property is ready. The Foundation will also pay the costs of salaries and materials needed for fundamental research and the Institute will provide the building, conversion costs, maintenance, and services. The Institute will also provide for the industry contacts to aid in the interpretation and utilization of the results of the fundamental research, as well as publicize these results.

Thus, while the Institute and Foundation continue to maintain their identities as separate organizations, each organization makes its important contributions to their common purpose—to provide a broad research program for the benefit of the textile industry.

Applied Research

We are now working on four projects in applied research:

* President, Textile Research Institute, Inc.

(a) Warp Sizing of Spun Rayons:

(b) The Production of Cotton Carding—being undertaken at North Carolina State College Textile School. We hope to have a progress report by January and to complete this by March 15th.

(c) Radiant Energy Drying: under way since July 1944 in space leased by the Institute from the Princeton Engineering School.

(d) On improved Insulation Fabrics—just being started at Princeton. A contract has just been signed with the National Electrical Manufacturers Association, who are sponsoring and financing this project.

Other applied research projects are under consideration.

Fundamental Research

We had hoped that it would be possible for this work to get started at Princeton in a small way by the first of the year, at which time the Foundation expects to complete a good deal of their war research work. It now looks as if this date were too optimistic. However, Dr. Eyring, our new acting director of fundamental research, and Dr. Rose, whose advice as counselor we have been fortunate to obtain, are working on plans recently submitted by Dr. Harold Smith's building plans committee. As soon as estimates are received we shall proceed as rapidly as possible. Some work has already started, and $24,100, outside of the above budget, is already available in our capital fund to start on this work. One of our greatest immediate needs is for added contributions to our capital fund to be used for the conversion of our Princeton building.

Graduate Training

We have already started this program, in cooperation with Princeton University, with one man. We have budgeted funds for four men at about $1,000 each, including tuition.

Economic Research

As Mr. Woolf's report shows, we have just started an important project on the "Competitive Position of the Post-War Textile Industry." This is being financed by the Textile Foundation.

Research Information and Magazine

Mr. Woolf's report outlines our plans for an enlarged and improved publication or publications. It has proved very difficult to produce a publication which will satisfy equally all of our varying interests, and both executives and research men. We believe that the changes proposed by Mr. Woolf and Mr. Jacobs will go a long way towards doing this.

We have had and will continue to have criticisms and headaches. I knew that when I took the job of trying to unite for a common purpose the many diverse interests and points of view which make up our membership. Yet we all have a common aim—to promote the welfare of the whole textile industry through research. With your support I am sure that we shall succeed.

Names of Institute's Company Members Who Have Signed on

New Membership Plan

Presented at Annual Meeting of Textile Research Institute, Inc. With Additions to November, 1944

Acksland Knitting Co.	N *
Acme Wire Co.	N
Affiliated Research, Inc	
Alrose Chemical Co.	
American Moistening Co.	N
American Viscose Corp.	
American Woolen Co.	N
Andrews & Goodrich, Inc.	N
Androscoggin Mills	N
Apex Chemical Co.	
Appleton Woolen Mills	N
Apponaug Co.	
Aridye Corp.	
Arkansas Co.	N
Arlington Mills	
Asso. Facty. Mutual Fire Ins. Co.	
Bancroft, Joseph & Sons Co.	
Barber-Coleman Co.	
Bates Manufacturing Co.	N
Bell Telephone Laboratories	N
Bigelow-Sanford Carpet Co., Inc.	
Botany Worsted Mills	
Bradford Dyeing Association	N
Brandon Corp.	
Broadalbin Knitting Co.	N
Brooklyn Yarn Dye Co.	N
Burlington Mills	
Callaway Mills	
Carbic Color & Chem. Co., Inc.	N
L. F. Carpenter & Co.	N
Cascade Woolen Mills	N
Celanese Corp. of America	
Chapal-Donner Corp.	
Cheney Bros.	N
Chicopee Manufacturing Corp.	
Clark Thread Co.	
Clover Spinning Mills, Inc.	N
Coats, J. & P., Inc.	
Cochrane, Charles P. Co.	
Cold Spring Bleachery	
Colloids, Inc.	
Commonwealth Color & Chemical Co.	
Continental Mills, Inc.	
Convenience, Inc.	
Corn Industries Resch. Foundation	
Cranston Print Works Co.	N
Cynthia Mills	N
Dickey, W. J. & Sons, Inc.	N
Dixie Mercerizing Co.	N
Dominion Textile Co., Ltd.	
Dow Chemical Co.	
Drackett Co., The	
Duplan Corp., The	
Earnshaw Knitting Co.	N
Eavenson & Levering	
Eddystone Manufacturing Co.	N
Edna Mills Co.	N
Edwards Manufacturing Co.	N
Electro-Technical Products, Inc.	N
Esmond Mills	N
Exchange Trading Corp.	N
Exeter Mfg. Co.	N
E-Z Mills, Inc.	
Fabric Research Laboratories, Inc.	
Forstmann Woolen Co.	
Fuller Brush Co.	N
Gantner & Mattern Co.	N
Gates Rubber Co.	
General Dyestuff Corp.	
General Electric Co.	N
General Mills, Inc.	
Gessner, David Co.	N
Globe Dye Works Co.	
Globe Knitting Works	N
Grantville Mills	
Hampton Co.	
Harodite Finishing Co., Inc.	N
Harts Products Corp.	
Hercules Powder Co.	
Hightstown Rug Co.	N

* N represents new member.

Hill Manufacturing Co.	N
Hird, Samuel & Sons., Inc.	
Hohokus Bleachery	N
Holmes, Archibald & Co.	
Hoosac Mills Corp.	N
Hubbard Felt Co., Ltd.	
Hunter, James Machine Co.	
Industrial Rayon Corp.	
Inst. Carpet Mfrs. America, Inc.	
Irvington Varnish & Ins. Co.	N
Jamison, James & Co.	N
Johnson, S. C. & Sons, Inc.	
Kerr Bleaching & Finishing Wks, Inc.	N
Keystone Tanning & Glue Co.	
Lavonia Manufacturing Co.	N
Lehigh Spinning Co.	N
Lincoln Mills of Alabama	
Linder & Co., Inc.	
Linen Thread Co.	N
Lockwood Greene Engineers, Inc.	
Louisville Textiles, Inc.	N
Manville-Jenckes Corp.	
Marshall Field & Co.	
Masland, C. H. & Sons	
McLean, Andrew Co.	N
Metakloth Co.	N
Mica Insulator Co.	N
Minot, Hooper & Co.	
Mohawk Carpet Mills	
Monomac Spinning Co.	N
Moss Rose Manufacturing Co.	N
Monsanto Chemical Co.	
Mt. Vernon-Woodberry Mills, Inc.	
National Lead Co.	
National Varnish Products Corp.	N
Netherlands, The Kingdom of the Economic, Financial & Shipping Mission	
New Jersey Wood Finishing Co.	N
North Amer. Lace Co.	N
Nuodex Products Co., Inc.	
Nye-Wait Co.	N
Ohio Falls Dye & Finishing Wks., Inc.	
Packard Mills, Inc.	N
Patons & Baldwins, Inc.	
Pepperell Manufacturing Co.	
Perfect Thread Co., Inc.	N
Philadelphia Carpet Co.	N
Proctor & Schwartz, Inc.	
Quaker Chemical Products Corp.	
Rider-Osborne-Devine, Inc.	N
Riegel Textile Corp.	N
Riverside & Dan River Cotton Mills, Inc.	
Robertson Bleach. & Dye Wks., Inc.	N
Rock River Woolen Mills	N
Rocky Mount Mills	N
Rohm & Haas Co.	
Rosemary Sales	
Roxbury Carpet Co.	N
Rumford Chemical Works	N
Scholler Bros.	N
Seamans & Cobb Co.	N
Seekonk Lace Co.	N
Skinner, Wm. & Sons	
Smith, Alexander & Sons Carpet Co.	
Solvay Sales Corp.	
Southern Mills, Inc.	
Standard Bleachery	N
Standard Chemical Products, Inc.	
Standard Insulation Co.	N
Stein, Hall & Company, Inc.	
Stearns & Foster	N
Stowe-Woodward, Inc.	
Sylvania Industrial Corp.	N
Tennessee Eastman Corp.	
Tenney, The A. M. Assoc., Inc.	
Toledo Dye Works	N
Troy Blanket Mills	N
Tubize Rayon Corp.	
Underwear Institute	N
Union Bleachery	N
United States Finishing Co.	N
U. S. Testing Co., Inc.	
Uxbridge Worsted Co.	
Verney Mills, Inc.	N
Wamsutta Mills	
Waverly Mills, Inc.	
West Point Manufacturing Co.	
Western Plastics, Inc.	N
Westinghouse Elec. & Mfg. Co.	N
Whitin, Paul Mfg. Co.	N
Whitman, Clarence & Sons	
Wilson, Thomas & Co., Inc.	N
Wyandotte, Wstd. Co., Inc.	
York Manufacturing Co.	N

Definite Plans for Further Progress Contained in Report on

Magazine and Information Service

By DOUGLAS G. WOOLF*

Presented at Annual Meeting of Textile Research Institute, Inc.

Mr. Woolf stated that a program had been developed for the future of the magazine, TEXTILE RESEARCH, to be put into effect as rapidly as possible. This will be announced in a later issue of TEXTILE RESEARCH.

The Information Service

The long-term objective of the information service is one which is thoroughly integrated with all the research aspects of the Institute, and with the magazine, providing for a two-way interchange of information between those departments and the information service. In other words, it is being designed to get from, and give to, the fundamental research department, the applied research department, the economic research department, and the magazine, as well as inquiries from outside, continually up-to-date information and leads.

In the plans of the building committee, provision has been made for a library, and an inventory is now being taken of the books and magazines available here in New York. A similar inventory has been secured of those books and magazines available through the Foundation in Washington A detailed plan will be prepared covering the items needed to complete the library, and to keep it up-to-date—and of course including the cost item.

Among its other functions, the department of information is also responsible for the preparation of supplementary reports. The most recent such report, to be ready for distribution at the Annual Meeting, presents a new format in that it is made the same page size as the magazine, to permit binding of both the publication and the reports together.

* Director of Information, Textile Research Institute, Inc.

Yarn Strength and Strength Variation As Affected by Speed of Loading on

The Moscrop Single Strand Tester

By GEORGE W. PFEIFFENBERGER*

Of the various methods employed for determining yarn strength, single strand yarn testing is probably one of the most controversial and least understood. Many people have avoided this type of test completely, stating that it was too slow and tedious to be practical. Others have asserted that there was no definite relationship between yarn strength as obtained by single strand methods and that obtained by the skein or lea test.

Objections as to tediousness and slowness have been largely overcome in the Moscrop single strand tester. This is an English designed and built device, which is semi-automatic in operation and rapid enough to be practical. It accommodates six bobbins at one time, automatically threads successive 10 inch lengths of yarn into the breaking clamps, and records the strength on an autographic chart. The older type Moscrop puts stress on the yarn by means of calibrated springs, and records the strength by punching holes in a paper chart graduated in ounces. The newer type has a pendulum loading arrangement, which employs the same loading principle as the conventional skein tester. The strengths are recorded in ounces by means of a recording pen. Sensitivity and capacity of the machine can be altered by using different weights on the pendulums.

The objection regarding the doubtful relationship between single strand and skein results has some validity. It is believed, however, that some of the disagreement may be in the method of testing, particularly the speeds at which the single strand samples are loaded and broken. The preliminary tests reported in this paper were made to ascertain the effect of different loading speeds on single strand yarn strength and strength variation. The results are reported, not as a basis for definite conclusions, but rather to stimulate interest in further studies in this field.

Cotton Yarns Used

The yarns selected for this study were chosen on the basis of substantial differences in most fiber properties of the raw cotton and of considerable differences in yarn strength as previously tested by the skein method. The principal points of difference between the two cottons are shown in Table I.

Test Procedures

The newer model Moscrop with pendulum loading was employed in these tests. Loading speeds of 1, 12,

* Cotton Technologist, Cotton and Fiber Branch, Office of Distribution, War Food Administration.

TABLE I. Fiber properties and skein strength of test cottons.

Item	Sample A	Sample B
Upper quartile length (inches)	1.12	1.23
Coef. of length var. (percent)	20	28
Weight per inch (micrograms)	3.9	4.7
Maturity (percent)	71	69
Tensile strength (1000 lbs./sq. in.)	82	72
Yarn strength (skein) (pounds)		
22s	120	96
60s	32	24

All tests were conducted under standard atmospheric conditions of 70 degrees F and 65 percent R.H., after the yarns had conditioned for at least 48 hours. Preliminary single strand tests failed to show any consistent effect on strength of the position of the yarn on the bobbins, so this factor can be disregarded.

TABLE II. Skein and single strand breaking strengths.

		Average corrected breaking strength				Coefficients of Variation			
		Skein	Single strand			Skein	Single strand		
		Loading speed	Loading speed			Loading speed	Loading speed		
Sample	Yarn count	1 Ft./Min.	1 Ft./Min.	12 Ft./Min.	24 Ft./Min.	1 Ft./Min.	1 Ft./Min.	12 Ft./Min.	24 Ft./Min.
	Number	Pounds	Ounces	Ounces	Ounces	Percent	Percent	Percent	Percent
A	22s	120.5	15.1	15.4	20.8	4.0	11.8	8.3	26.3
B	22s	95.9	11.6	13.5	9.6	3.6	16.2	6.8	55.3
A	60s	31.5	4.4	4.8	2.5	6.1	20.4	10.1	88.6
B	60s	24.1	3.0	4.0	1.1	5.4	23.1	18.8	36.1

and 24 feet per minute were selected for the following reasons:

1. One foot per minute is the speed specified by the A.S.T.M. for all yarn strength testers, whether skein or single strand.
2. Twelve feet per minute was the operating speed of the machine as received from the manufacture. It was presumed, therefore, that there was some basis for this particular rate of loading.
3. Twenty-four feet per minute was the operating speed of a spring loading Moscrop machine as received in another laboratory some years ago. Presumably here, also, there was some basis for establishing this high speed.

Presentation and Discussion

The strength test results for averages of six bobbins of yarn per lot are presented in Table II. The data include the breaking strength corrected to nominal counts, and the coefficient of variation for each of the Moscrop speeds, as well as the comparative skein test data. Photographic reproductions of typical sections from each original autographic chart are shown in Figures 1 and 2 as characteristic illustrations of the differences caused by varying the loading speeds. From the table and charts, certain relationships between loading speeds and the resulting yarn strength are readily apparent. In each case, except that of the

22s yarn of the longer cotton, sample A, the middle speed produces the highest average strength. Throughout the tests the low speed of one foot per minute produced substantially lower strengths than did the middle speed. Except for the 22s yarn of sample A the highest speed produced the lowest strengths. Two questions are raised by these results. Which is the proper speed for the most accurate measurement of strength? Why was the one test on the 22s yarn of sample A so different from the general trend?

Analysis of the charts and close observation of the machine in operation indicate that at high loading speeds the factors of inertia and momentum are involved. The tendency indicated on most of the high speed charts for the breaks to group themselves into a bi-modal frequency supports this statement. There are a number of high and a number of low breaks, with a noticeable lack of medium values. This is contrary to anything found in the skein test, or other breaking strength tests on textile materials. A supplemental check on this was made by testing a relatively weak 22s yarn at the high speed only, but varying the capacity of the machine. When the yarn was broken at high speed with the machine adjusted to maximum capacity by employing a heavy set of pendulums, the strength averaged approximately four ounces. When yarn from the same bobbins was broken with the tester at medium capacity by using medium weight pendulums the average strength was 15 ounces. No test was made at low capacity as the pendulums are too light for 22s yarn. Obviously the heavy pendulums offer greater inertia, and as the yarn is loaded at high speed the specimen receives a considerable shock. Frequently the specimen under test is too weak to withstand this shock and the pendulum is moved only slightly, thus recording a very weak break on the chart. The lesser inertia of the lighter pendulums permits them to be moved to a greater degree when the stress is applied to the yarn, with the result that considerably higher average breaks are obtained. The variation in strength of the successive 10 inch specimens along the length of the yarn is the reason for the bi-modal distribution of breaks. Occasionally a strong specimen occurs which will withstand the initial shock and put the pendulum and pens into rapid motion. Observation of the machine discloses that in such cases there is a momentum built up in the pen, and it sometimes travels beyond the actual point of rupture of the yarn, resulting in a false recording of high breaks on the chart. In the 22s yarn from sample A all of the successive 10-inch specimens were strong enough to withstand the initial shock and consequently all the recordings are high.

It is believed that the impracticability of testing at speed as high as 24 feet per minute is clearly observable on the charts. It is quite unreasonable to accept data showing a breaking strength of 21 ounces for 22s yarn, and only 2½ ounces for 60s yarn of the same cotton with the same twist multiplier.

Comparison with Skein Data

Because of the physical difference between the skein and the single

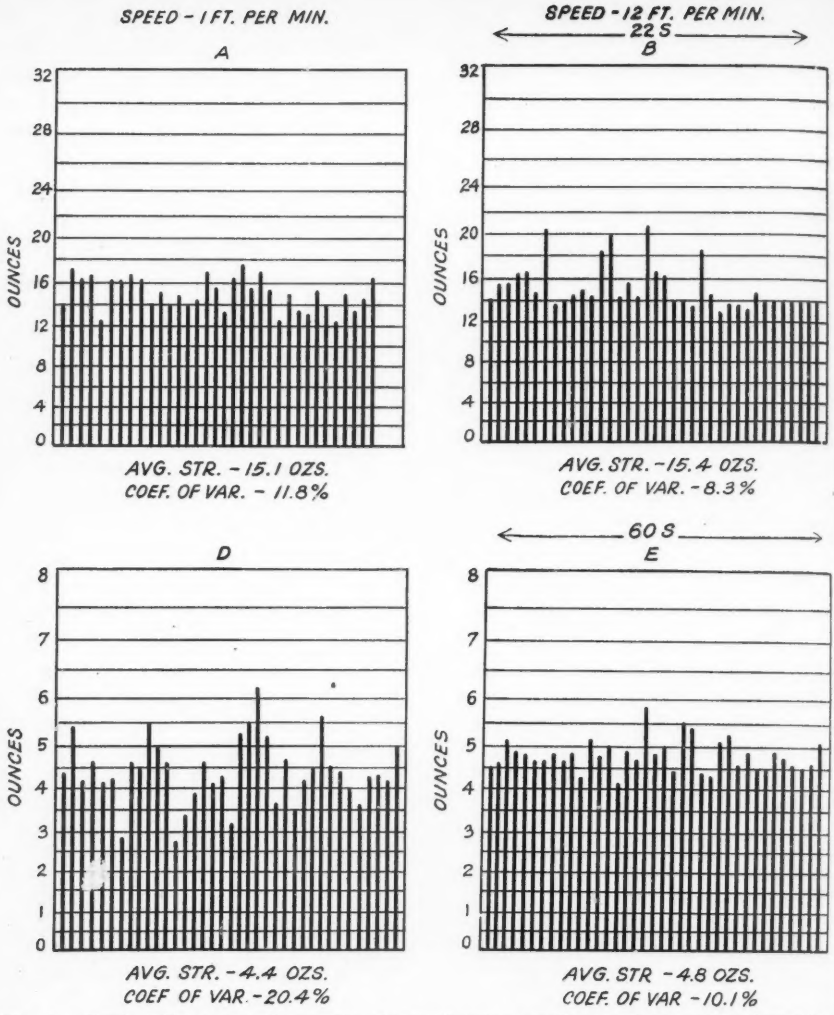
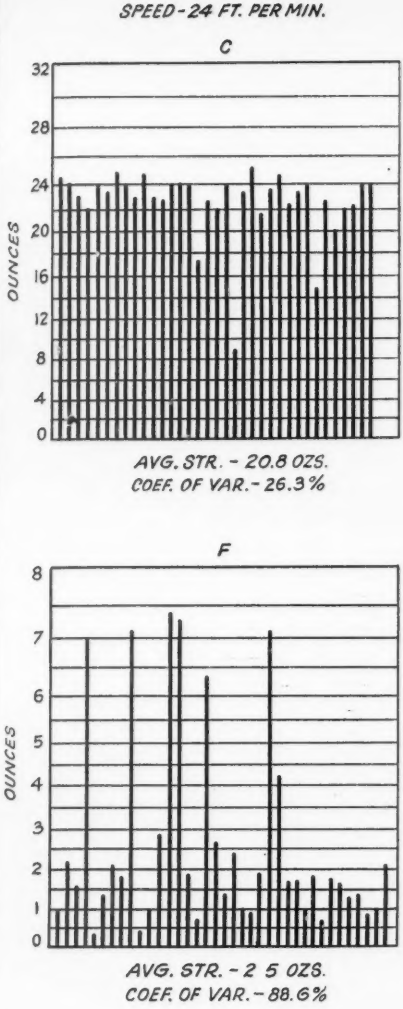


Fig. 1. Typical Moscrop autographic charts showing single strand breaking strengths and strength variations obtained at different yarn loading speeds (Sample A). Charts A, B, & C are for 22s yarn; Charts D, E, & F are for 60s yarn.

strand methods, and the difference in the units of strength measurement, the data from one type of test cannot be compared per se to the other. They can, however, both be put into a common unit by expressing the results as ratios, in each case, of the strength of 22s yarn to that of the 60s yarns. This



has been done, with results as presented in Table III. The ratios obtained in the low speed are very close to those obtained by the skein method.

TABLE III. Ratio of 22s yarn strength to 60s yarn strength, both spun from same cottons.

		Single strand ratios		
Sample	Skein ratios	1 Ft./Min.	12 Ft./Min.	24 Ft./Min.
A	3.83	3.43	3.21	8.32
B	3.98	3.87	3.38	8.73

The middle speed ratios, while not greatly different, are consistently farther from the skein ratios than are those for the low speed. The high speed ratios are completely out of line, as it is inconceivable that 22s yarn would be over eight times as strong as 60s from the same cotton.

A study of the data on strength variation indicates extreme differences in coefficients of variation for the different loading speeds. The low speed produced a medium variation in every case, the middle speed indicated lowest variation, and the high speed gave extremely high variations. The low speed test indicated that the sample A was more uniform for both yarn counts than sample B. The middle and high speeds, however, were inconsistent in this respect. The middle speed indicated sample A to be more variable than sample B for the 22s yarn, but less variable for the 60s yarn. The high speed produced exactly opposite results. The inconsistencies in variation can be attributed to the initial severe shock on the yarn at the start of loading, and the resulting opposite reactions of weak and strong 10 inch specimens.

A summary of the data, coupled with close study of the charts, indicates very definitely that the highest speed of 24 feet per minute can be discarded

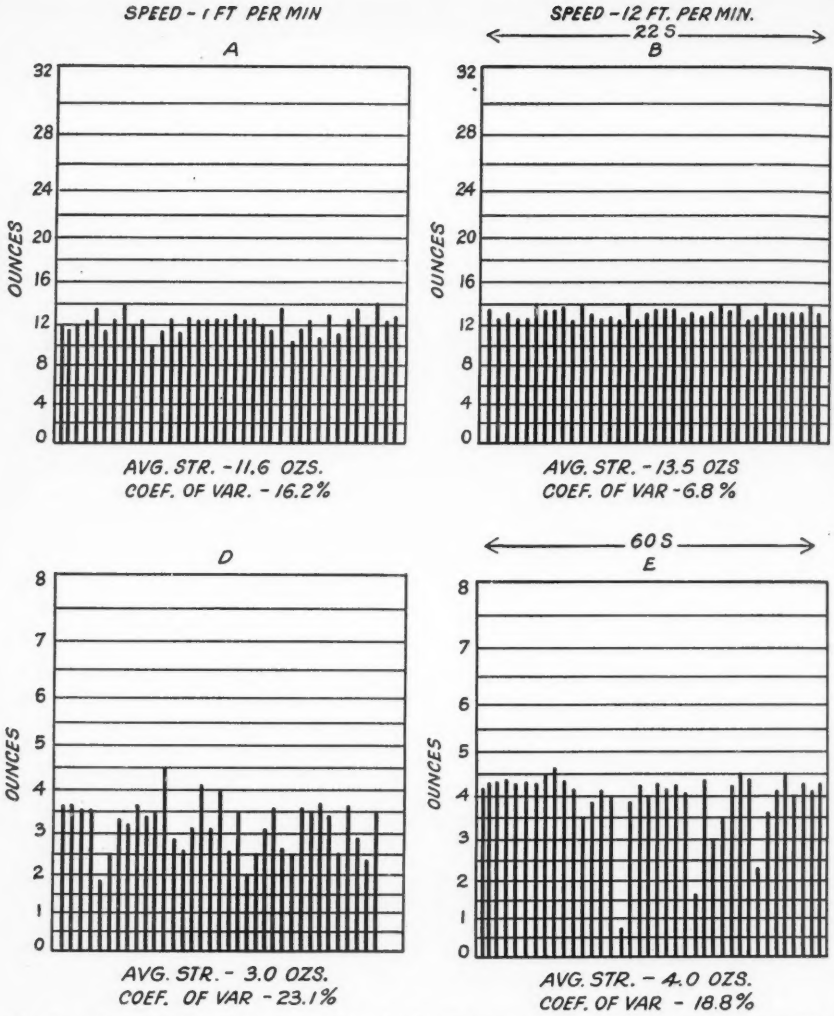
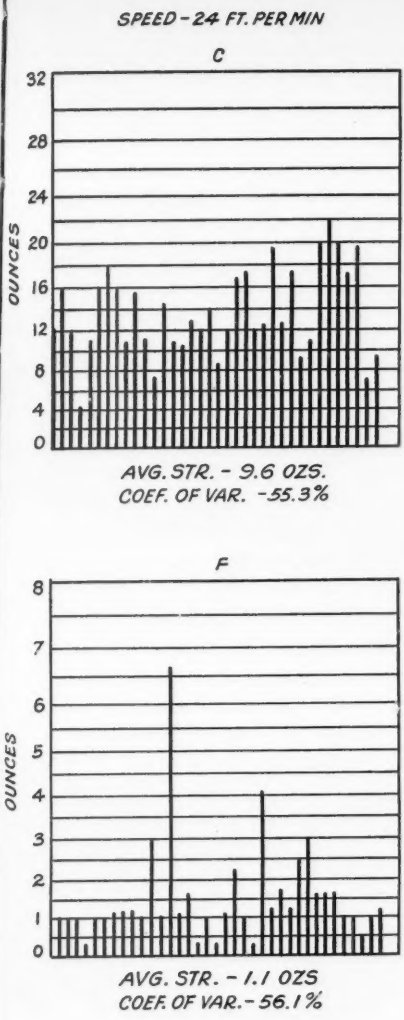


Fig. 2. Typical Moscrop autographic charts showing single strand breaking strengths and strength variations obtained at different yarn loading speeds (Sample B). Charts A, B, & C are for 22s yarn; Charts D, E, & F are for 60s yarn.

as inaccurate. Although the average strength differences between the low and middle speeds are not large, the data indicate the low speed as the more logical choice for accurate work. The slow steady pull not only discovers small differences in strength between the successive 10 inch test specimens, but it also provides results which agree more closely with the skein data in the relative strengths of the different cottons, and of the dif-



ferent yarn counts for the same cotton.

Although not dependent on these data, there are other practical reasons for standardizing on the low speed of one foot per minute. If only as a matter of good laboratory practice it is advisable to operate all strength testing machines at the same speed. Furthermore, unless actual test data justified a change, it is advisable to adhere to the A.S.T.M. specification of a speed of one foot per minute for both skein and single strand testers, as results so obtained are on a well known standardized basis, and require no conversion or explanation. There is need, however, for comprehensive studies as a basis for more definite conclusions with respect to the technique most suitable for dependable results in single strand testing with the Moscrop tester.

Annual Index

Because of unavoidable delays in printing it has been impossible definitely to schedule the mailing of the index to Volume 14 of TEXTILE RESEARCH *with the December issue. It will, however, accompany the January, 1945, issue.*

ABSTRACTS

Members of Textile Research Institute, Inc., desiring complete copies of articles abstracted may obtain photostat copies at cost by addressing the Institute's office, 10 East 40 St., New York 16, N. Y. The price of a photostat negative is seldom more than 30 cents per page of original text.

Translations of articles appearing in foreign language publications and abstracted in TEXTILE RESEARCH, *will be furnished at cost when the original publication is obtainable.*

A list of periodicals abstracted in TEXTILE RESEARCH *and the abbreviations used appeared on page 32 of the January, 1944 issue of* TEXTILE RESEARCH.

Reprints of Abstracts Available

In line with plans reported at the annual meeting of the Textile Research Institute, Inc., arrangements have been concluded whereby reprints of the abstracts of textile articles appearing in the Institute's magazine, TEXTILE RESEARCH, will be made available to readers of the publications at cost. These will be printed on one side only, for purposes of filing. They will be mailed as soon after publication as possible. The cost per year, per reader, is $2.50, covering printing and mailing. This service starts Jan. 1, 1945. Orders should be sent to Textile Research Institute, Inc., 10 East 40th Street, New York 16, N. Y.

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ANALYSIS: TESTING LABORATORY METHODS

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Electron Microscopy

Dark field illumination in electron microscopy. G. B. Levy. *J. Applied Phys.* **15**, 623–5 (Aug. 1944).

A method is described to obtain dark field illumination with the RCA type B electron microscope. Several micrographs are shown, indicating the usefulness of this technique.

Studies with the electron microscope diffraction adapter. R. G. Picard. *J. Applied Phys.* **15**, 678–84 (Sept. 1944).

The accuracy of the results obtained in electron diffraction analysis, using the RCA diffraction adapter for its electron microscopes and a weak magnetic lens to focus the diffraction patterns, is discussed; and it is shown that lattice spacings may be determined with an accuracy of one per cent if reasonable precautions are observed in calibration and operation of the instrument. A method is also described for measuring the accelerating voltage of the electrons from data obtained from the diffraction pattern. Electron diffraction patterns are shown of a number of thin film materials which are commonly used as specimen supports in electron diffraction analyses and electron microscopy. The effects of aging and beam exposure on the patterns produced by these films are determined.

A closed cell for electron microscopy. I. M. Abrams and J. W. McBain. *J. Applied Phys.* **15**, 607–9 (Aug. 1944).

A simple closed chamber for electron microscopy has been devised. The plastic windows interfere very little with electron examination and they are liquid and vapor tight and easily withstand a difference of one atmosphere pressure between the inside of the cell and the remainder of the electron microscope. This cell will allow the use of specimens free of desiccation at the high vacuum.

Some limitations of electron microscopy in examining specimens in liquid or attempting to observe ordinary Brownian movement have been emphasized. Particles in free Brownian movement necessarily elude observation.

Fiber Identification

Systematic identification of textile fibers by chemical means. Antonio Algerino. *Laniera* **57**, 69–73 (1943); *Chem. Zentr.* 1943, II, 2029 (through *Chem. Abstr.*, 1944, **38**, 6101[7]).

Regents needed are acetone, glacial AcOH, H_2SO_4 (d. 1.672), basic Zn chloride (d. 1.835), 10% KOH, 10%NaOH, Fehling solution, 10% $CuSO_4$, and Na_2S. The analytical procedures and the detection of acetate rayon, nylon, silk, wool, Lanital, viscose rayon, hemp and cotton are discussed.

Microanalysis

Microanalysis by means of electrons. J. Hillier and R. F. Baker. *J. Applied Phys.* **15**, 663–75 (Sept. 1944).

A new type of electron optical instrument is described. By the application of an electron probe of extremely fine dimensions, it is possible to obtain, with high resolving power, the velocity distribution in a beam of electrons transmitted by a thin specimen. By further application of the electron probe, the region of the specimen transmitting electrons can be made very small and can be accurately located in a specimen. Preliminary tests have shown that is possible to observe and measure the discrete amounts of energy lost by the incident electrons in inelastic collisions with the inner electrons of a number of elements.

Particle Size

Particle size analysis. E. N. Harvey, Jr. *Interchem. Rev.* **3**, 59–70 (Autumn, 1944).

Particle size measurement and control and knowledge of size distribution and particle shape are of great importance in pigment, paint and related industries, and in many diverse industrial processes. The methods of expressing size distribution, types of measurement and their significance, and methods of determining particle size experimentally, are reviewed. Particle size data must be treated statistically, and this is complicated by the fact that particles are three-dimensional; terms used in such statistical analysis are defined and illustrated. Principle size-range categories are sieve and sub-sieve, the latter being divided into microscopic and sub-microscopic or colloidal. Direct methods of measuring size distribution are wet and dry screening, observation with white, blue and ultraviolet light microscopes, and the electron microscope; semi-direct methods include sedimentation, elutriation, and turbidimetric analysis; indirect methods are ultramicroscope techniques and permeability and adsorption methods. Measurement by screening is limited to particles of 40 microns diameter or greater (most pigments are of smaller particle size than this); the limit of resolution of an ultraviolet microscope is 0.1 microns; the electron microscope has lowered this limit to 0.004 microns, and has permitted much more precise determinations than previously possible with such pigments as carbon black, iron blues, and organic colors. It is pointed out that finely divided substances have properties differing widely from the same substance in bulk. In many cases the optimum size for a particular purpose lies in a specific range between coarse and very fine, and control is thus of great importance.

Permeability Tests

Water vapor permeability of moisture sensitive materials. G. J. Brabender. *Paper Trade J.* **119**, 52–5 (Oct. 19, 1944).

A composite sheet material such as moistureproof triple-ply glassine offers particular difficulty in the determination of its water vapor permeability by accelerated methods. The cellulosic matter in such a sheet has a marked tendency to absorp water whereas the two films of microcrystalline wax act as effective barriers to water vapor transfer. This type of construction demands that special attention be paid to the factors of (a) sheet distortion on the test cell, (b) the prolonged period

before the sheet reaches equilibrium with the testing conditions and (c) a low rate of change in weight due to true water vapor transfer. Precise control over the atmospheric conditions within the testing cabinet is of definite importance. Certain advantages in making permeabilty tests have been found by using a light-weight test cell made as a shaped, seamless metal ring having two open faces. Test assemblies made up with such cells have a low gross weight, a small volume of confined air, occupy a small space in the cabinet, tend to minimize sheet distortion and provide a fairly large test area. Ordinary rosin is not recommended as a component in the sealing medium for water vapor permeability tests because of its tendency to gain weight under high humidity and temperature conditions. This gain in weight is probably due to both oxidation and moisture absorption. Certain microcrystalline waxes and specially treated rosins have been found to be free from these defects and have other suitable properties for use in sealing compounds.

Identification of Synthetic Resins

Systematic procedure for identification of synthetic resins and plastics. T. P. Gladstone Shaw. *Ind. Eng. Chem.*, Anal. *Ed.* **16**, 541–9 (Sept. 1944).

A procedure for identifying synthetic resins is outlined, including most resins of commercial importance at the present time. Once the resin has been isolated in as pure a condition as possible, it is necessary to determine to which of eight groups (designed by letters A to H) it belongs, then to proceed systematically to its tentative identification. Confirmatory tests are applied to confirm or disprove this. In the latter event, or if short cuts are possible because of the history of the resin, use is made of the classification of the properties (given in a number of tables) for the various general types of resins. Cases will occur where the confirmatory tests do not yield a clear-cut identification. This may be caused by imperfect separation of a mixture or by the presence of a resin which is not covered in this paper. Some general reactions are given which will help to identify the resin in such cases. The scheme will not distinguish between different degrees of polymerization of the same monomer.

CHEMICAL AND PHYSICAL RESEARCH

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Structure of Cellulose

Structure of cellulose. W. T. Astbury and M. M. Davies. *Nature* **154**, 84 (July 15, 1944), (Through *Bull. Inst. Paper Chem.* **15**, 6 (Sept. 1944)).

The configuration of the pyranose ring as suggested by Pierce (see abstract below) appears unnecessary and unjustified by the evidence, the latter being more in favor of the Sachse strainless ring.

Structure of cellulose. E. G. Cox. *Nature* **154**, 84–5 (July 15, 1944), (Through *Bull. Inst. Paper Chem.* **15**, 6 (Sept. 1944)).

In the light of more recent results, the deductions drawn from the earlier work on which Pierce (see abstract below) bases his new model, appear less conclusive. Very detailed analyses of sugars, in which the atomic portions have been fixed to rather better than 0.1 A., have produced no evidence that the pyranose ring departs from the Sachse *trans* conformation.

Relationship between morphological structure and chain length in native cellulose fibers. H. Dolmetsch, E. Franz and E. Correns. *Kolloid-Z.* **106**, 174–87 (1944) (through *Chem. Abstr.*, 1944 **38**, 6091[2]).

Fiber structure, particularly of the 3 layers of the secondary wall (spruce fibers as examples), is discussed. A new fiber-building principle for axially built cellulose fibers is proposed. With this principle, along with the known structural elements, the authors found it possible to define, theoretically, the smallest individual fiber-building units. The presence of these units was confirmed by microscopic examination of wood fibers treated with suitable swelling agents and solvents. These smallest units fulfill, in their construction, all of the conditions necessary for the conception of micellar or crystalline structure of

fibers. The length of these units is of the order of magnitude of the chain length of the highly polymerized portion of cellulose nitrate, as determined by viscometric means, whereas their breadth corresponds to that of the cellulose fibrillae. The ends of these units lie in plane faces which spiral slightly throughout the secondary wall from one end of the fiber to the other. These plane faces are made visible, by suitable swelling procedures, as cracks in the fiber walls. The average distances between these cracks should indicate the original unit chain length of the native cellulose fiber.

Molecular co-ordination in cellulose. F. T. Peirce. *Nature* **153**, 586–7 (May 13, 1944), (Through *Bull. Inst. Paper Chem.* **15**, 6 (Sept. 1944)).

The arrangement of the glucose residues within the unit cell of cellulose is reconsidered in view of results of earlier studies by Cox and co-workers of the cry allo-chemistry of the sugars. Their view that the five carbon atoms of the pyranose ring are nearly co-planar is expressed in a new model (suited to geometrical calculation) built on the assumption of tetrahedral carbon bonds with a right angle between the bonds of the ring oxygen. It is claimed that the new model fits into the cellulose lattice better than the hitherto generally accepted Sachse form of a strainless ring (*trans* or "armchair" form).

Reactivity of Cellulose

The reactivity of pulps. G. Jayme. *Cellulosechem* **21**, 73–86 (Sept. 1943). [In German] (Through *Bull. Inst. Paper Chem.* **15**, 26–7 (Sept. 1944)).

The author discusses the swelling of cellulose in the presence of water, the changes in cellulose on drying, with special reference to fine structure, and the cornification (I) of pulps. New data are presented. Three chemical factors are listed which affect the tensile strength of pulps: the D.P., lignin content (II), and hemicellulose content (III). The effects of these on pulp properties are discussed at length. Whereas pulps high in II take up more moisture than those practically free from II, the presence of II seems to inhibit swelling. With increasing II content, sheet density diminishes, which is noteworthy, because III, which also increases with rising II content, has exactly the opposite effect on sheet density. The methods used in purifying pulps, to remove III are important. Hot aqueous sodium hydroxide has a very different effect from cold sodium hydroxide. The "passivity" of pretreated pulps toward acetylation has been used as a measure of reactivity. A more recent method (unpublished thesis of Steinmann, Darmstadt, 1940) depends on measuring the heat generated when a mixture of acetic acid, acetic anhydride, and sulfuric acid acts upon the pulp under standardized conditions. The time required to reach the maximum temperature is also measured. Studies were also made of amounts and compositions of insoluble residues after acetylation. In general, it was possible to recognize the type of treatment used in purifying pulps produced for acetate manufacture. Sharp drying, prior to alkaline treatment, caused marked losses in reactivity. Further treatment prior to acetylation was only successful when the water in the moist pulp (that had never been subjected to long drying) was replaced by acetic acid. The "sealed capillaries" of the predried pulp are gradually "opened" by the action of acetic acid with a concomitant increase in reactivity. The reactivities of alkali-treated pulps towards water and acetic acid are discussed at length, as well as their reactivity toward xanthation. The latter appears to be related empirically with a-cellulose, brightness, and xanthate viscosity. Post-treatment of dissolving pulps with acid or bleach appears to enhance their reactivity on xanthation. Heiniger has devised a method for determining the reactivity of pulps dried in various ways towards water sorption. This is a measure of the irreversible I. Details of the work have not yet been published, but it depends upon the fact, that, when moist pulp is introduced into dry dioxane, only a portion of its water is taken up by the solvent. This can be accurately measured by determining the change in dialectric constant, which rises about 12% for every 1% of water dissolved. 40 references.

Coupling Reaction

The mechanism of the diazo-coupling reaction. III. Some unusual coupling phenomena and their interpretation. H. Hodgson and E. Marsden. *J. Soc. Dyers and Colourists* **60**, 120–4 (May, 1944).

The general mechanism put forward previously is shown to interpret the coupling of phenols and naphthols, including the special cases of salicylic acid, 4-nitro-2-naphthol, resorcinol, and 1:5 dihydroxy-naphthalene; the mobility of the azo-hydrazone equilibrium as altered by pyridine and nitrobenzene; the coupling of amino-compounds; the dicoupling of H-acid and the exclusive monocoupling of γ-acid and J-acid; the effect of pyridine on the coupling reaction; the diazo-exchange reaction; and the coupling of phenol ethers. A re-interpretation of the older oxonium and ammonium theories of coupling is given on the basis of modern electronic and resonance theory.

Detergency

Considerations of detergency with special reference to sodium secondary alkyl sulphates. R. G. Aickin. *J. Soc. Dyers and Colourists* **60**, 170–6 (July, 1944).

The effect of a number of electrolytes on the removal of olive oil from wool by sodium secondary alkyl sulphates has been studied. Initial reduction in efficiency of the process by addition of electrolytes is followed by a very large increase in efficiency at higher concentrations. The electrolyte effect is largely due to the ions of sign opposite to that of the long-chain ions, and divalent ions are much more active than univalent ions. Univalent ions fall into a series as regards their influence: $K^+ > NH_4^+ > Na^+ > Li^+$. The observed effects are explained in terms of the interfacial forces existing between the oil, the detergent solution and the textile fiber. The stability of the emulsion produced by dispersion of the removed oil in the detergent solution is another major factor involved.

Dimethylaniline and Nitric Acid

A theoretical study of the interaction of dimethylaniline and nitric acid. H. H. Hodgson. *J. Soc. Dyers and Colourists* **60**, 151–3 (June, 1944).

The reaction of nitric acid of seven different densities with dimethylaniline at 0° C is described. No reaction occurs with acid of *d* 1.046 and *d* 1.024. When the temperature is allowed to rise by the heat of reaction, expulsion of a methyl group occurs with acids of *d* 1.34 and *d* 1.254, but not with acid of *d* 1.12. Addition of sodium nitrite accelerates the reactions, while addition of urea inhibits them. The reactions of 3:3′:5:5′-tetranitrotetramethylbenzidine with acids of *d* 1.52 and *d* 1.42 are analogous to the reactions of these acids with dimethylaniline or 2:4′-dinitrodimethylaniline. All these reactions are interpreted from the standpoint of modern electronic theory.

Elasticity of Keratin Fibers

Elasticity of keratin fibers. Henry B. Bull and Martin Gutmann. *J. Am. Chem. Soc.* **66**, 1253–59 (Aug. 1944).

The stress-strain curves of human hair immersed in water with a constant rate of load of 0.470 grms. per minutes were investigated. The stress-strain curves are reproducible up to 20% stretch. Except for a small initial region both the elongation and contraction curves are irreversible. Irreparable damage to the hair commences at 18% elongation. "Equilibrium" loads have been determined. The effect of temperature was investigated. It is suggested that Astbury's newer structure for alpha keratin is too condensed. The principal characteristic of alpha keratin is the close packing of successive alternate amino acid residues along the peptide chain. The stretching of hair between 3 and 20% is similar to the thixotropic gel-sol transformation of iron oxide.

Analysis of Pectic Substance

Pectic materials. III. Max Lüdtke and Heinrich Felser. *Cellulosechem.* **21**, 86–94 (Sept. 1943). [In German] (Through *Bull. Inst. Paper Chem.* **15**, 23 (Sept. 1944)).

Green flax dust, freed from extractives and

from pectin A, was subjected to various treatments for the isolation of pectin B (I). These included aqueous hydrochloric acid and sulfuric acid, followed by ammonium oxalate (II); calcium acetate, followed by ammonium hydroxide, hydrochloric acid, and II; calcium hydroxide, followed by hydrochloric acid and II; chlorine followed by pyridine and alcohol, and by II; hydrogen peroxide, followed by II; and chlorine dioxide, followed by pyridine and II. The lime methods gave the best yields (10.1%) of I $(a)_D^{20}$ 187 to 213° (0.1N sodium hydroxide). Hydrogen peroxide gave apparently high yields of I, but only part of this was true pectin as shown by $(a)_D^{20}$. Hydrochloric acid extraction proved more satisfactory than sulfuric acid. Various methods are given for the purification of I, for the preparation of pectic acid and alkali pectin from I, and also for the partial hydrolysis of I to form polygalacturonic acid. In no cases were "pure" products obtained. However, galacturonic acid, arabinose, and galactose were definitely identified among the cleavage products of crude I. Seven tables and 11 references are given.

Hydrolysis of Starch

Extent of hydrolysis of starches by amylases in the presence and absence of yeasts. William Ward Pigman. *J. Research Natl. Bur. Standards* **33**, 105–20 (Aug. 1944).

The extent of enzymic conversion of corn starch, waxy maize starch, and potato amylose into materials fermentable by yeasts was studied for a number of different types of amylases. When the amylases are allowed to act on the starch substances, complete conversion to fermentable material may take place when the yeasts are allowed to act in the presence of the enzymes but not when the amylases and yeast act separately. The amylases that are capable of bringing about complete conversion are the cereal *a*-amylases and the fungal amylases. Certain bacterial amylases, pancreatic amylases, and the cereal *B*-amylases convert starch only partially to fermentable substances in the presence of yeasts. The experiments described in the present paper were carried out at starch concentrations comparable to those employed in industrial grain-alcohol processes. With the notable exception of the malt amylases and the *B*-amylases, all of the enzyme preparations studied are capable of synthesizing unfermentable substances from maltose and presumably from starch hydrolysis products. For certain of the enzyme preparations, this synthesizing action provides an explanation for the lack of complete conversion of the starches to fermentable materials. For other enzymes, however, other explanations are more probable. The nature of the actions of the amylases are considered in relation to the structures of the starch substances. Improved procedures are given for the preparation of soybean *B*-amylase and of potato amylose. Methods are described for bringing starches into solution without preliminary gel formation.

Substantivity

Substantivity and its role in textile processing. A. M. Schwartz. *Am. Dyestuff Reptr.* **33**, 164–168 (Apr. 10, 1944).

The term "substantivity" is used to describe the affinity of a dyestuff or finishing substance for a fibrous material (chiefly cellulosic) in particular as measured by fastness to water washing or soaping. The mechanism of dyeing cellulosic material with the water soluble substantive dyes, and the nature of the affinity forces involved, is discussed. It is pointed out that since secondary valence forces come into play only with close contact between cellulose and dye, it is necessary to thoroughly clean the fiber before dyeing. Aftertreatments to make direct dyes faster to water all depend on decreasing the solubility of the dye without altering the dye-cellulose forces. Substantivity is equally important in the case of completely insoluble materials, examples of insoluble substances of high affinity being naphthol dyes, vat dyes, mineral dyes, and aniline black. Urea-formaldehyde resin is said to be held in the fiber partly by cellulose-resin secondary valence forces and partly by a submicroscopic mechanical interlocking of resin chains and cellulose chains. A second type of substantivity depends upon the fact that wet cellulose is a nega-

tively charged colloid; thus in the case of certain suspensions and wax emulsions and in catonic softeners, electrical rather than valence forces play the leading role. The problem of adhesion (to outer surface), fundamental in additive finishing, is essentially one of affinity operating exclusively on the surface of the substrate material. It is to be expected that synthetic polymers will be developed having improved adhesion to cellulosic surfaces thereby permitting production of permanent effects with lighter coatings than now possible.

Wool Damage

The utilization of wool by four saprophytic micro-organisms in the presence of additional nutrients. Hirschmann, Zametkin and Rogers. *Am. Dyestuff Reptr.* **33**, 353–9 (Aug. 14, 1944).

The extent of growth of Bacillus mesentericus, B. subtilis, Actinomyces albus and Chaetomium globosum in various liquid and solid media in the presence and absence of degreased sterilized wool fabric was determined. These micro-organisms had been previously reported as capable of attacking wool. Details of test methods and results are given. Results indicated that though the wool fiber is relativey resistant to these organisms, the products of hydrolysis of wool are readily utilized by them. A. albus, in the presence of nutrients, was the most active organism in disintegrating wool fiber; C. globosum grew more generally under all the test conditions used but damaged the fiber less than A. albus.

Hairiness in Wool

Significance of hairiness to the wool textile industry. I. Romney Hogget wools. S. Townend and P. R. McMahon. *New Zealand J. of Science and Technology, Agricultural Section A.* **26**, 1–20 (June, 1944).

In the first of a series of experiments designed to discover the real importance of hairiness (medullated fiber) to the woolgrower, manufacturer, and user, two batches of raw wool have been followed with detailed observations throughout all stages of processing to the finished fabric. In this trial the wool used was obtained from about seven hundred unculled stud Romney ewe hoggets—not shorn as lambs—from a flock not greatly superior to the standard of all Romney stud sheep in the Dominion. The two batches contained: (A) 198 lb. of wool from the sheep graded highest for freedom from hairiness; and (B) 203 lb. from the sheep graded lowest. Although the *difference* in hairiness between the two batches was relatively small and equivalent to only 4.6 percent of coarse, hairy fiber it was clearly visible in the bulked raw material. This difference did not affect the processing properties of the wool, and produced no marked difference in appearance and handle of either woven or knitted fabrics; it could not be detected in finished cloths dyed navy blue in either an acid or a neutral bath. This work in intended to be a preliminary investigation and must eventually embrace different degrees of hairiness and different classes of wool, especially those of finer quality.

BLEACHING: DYEING FINISHING

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Peroxide Bleaching

Continuous peroxide bleaching. The technical staff of the Buffalo Electro-Chemical Co., Inc. **III. Equipment.** *Am. Dyestuff Reptr.* **33**, 385–8, 401–2 (Sept. 11, 1944). **Part IV. Adaptability.** *Ibid.* **33**, 405–7 (Sept. 25, 1944).

High operating efficiency in continuous peroxide bleaching depends on the design, dependability, and ruggedness of each unit in the range which includes padders, saturators, squeezers, washers, pilers, J-boxes and auxiliary equipment. Each of these units is clearly pictured and its desired features and functions discussed. It is noted that the speed of the washing equipment imposes the limit on range speed; there is a need for higher speed washers with the washing efficiency of the 150-yard per minute slack washer. Four types of steam bleaching ranges, for use with different types of fabric and for small or large production volume, are described.

The stainless steel J-box is the heart of the system in which all parts of the bleaching may be synchronized to result in a completely continuous procedure from the gray room to the white room; mercerizing and finishing may be carried out in conjunction with the bleaching; this method will turn out on one range the same amount of cloth requiring eight or ten kiers, and in two and one-half hours instead of twenty. Data on floor space, equipment and chemical costs, and steam, water, power, labor and maintenance requirements are given. Substantial savings are indicated for plants with a weekly volume of 400,000 yards or over.

Stripping Wool

Stripping of dyed woolens and other textile materials. H. Jowett. *J. Soc. Dyers and Colourists* **60**, 197–200 (Aug. 1944).

Methods of stripping dyed textiles can be divided into (1) treatment with acids, alkalies and salts, (2) oxidation, (3) reduction, and (4) combination methods. Choice of which method to use is governed by the type of fiber, the dyes present, and the amount of dye to be removed. The various stripping methods are discussed and their practice described. Shoddy which may contain several dyestuff types frequently requires both oxidation and reduction treatment to remove all the color; since in such treatments the color is not removed or solubilized, but destroyed, the ground is usually left discolored or dull by more or less neutral-colored decomposition products. Certain vat dyes may be partially removed from the fiber by reducing as usual and treating in the presence of agents normally used as levelling or retarding agents to prevent the color which is removed from redyeing. Dyes may sometimes be stripped from cellulose acetate by a boiling soap bath with or without the addition of activated carbon, or by means of acidified hypochlorite.

Continuous Solvent Scouring

Continuous solvent scouring of woolen and worsted goods. Anon. *Textile World* **94**, 94–5 (Oct. 1944).

Reports from mills that have installed equipment for solvent scouring show an increase in efficiency and economy by this method. Some of the advantages of this method are (1) less damage to fabrics, for example, worsted or woolen crepes and cotton-backed boucles which are usually somewhat damaged by wet-finishing operation of scouring with soap and alkali when processed by solvent-scouring for a finish almost unattainable by older methods; (2) fabrics can be fulled without soap and in cases where soap is indicated, the amount of soap can be reduced at least 70%; (3) the effect of dry cleaning on colors is to produce a brighter and clearer appearance; and (4) the lubricating oil used for carding and spinning can be recovered and used again along with recovery and re-use of the solvent.

Dyeing Acetate Rayon

Changes of dyes on acetate rayon. W. Jaeck. *Teintex* **8**, 37–38 (1943); *Chem. Zentr.* 1943, II, 1925 (through *Chem. Abstr.*, 1944, **38**, 6100⁶).

Fading of the dyes in contact with combustion gases of illuminating gas is due chiefly to NO. Indophenol derivatives are especially susceptible. J. proves experimentally that NO and not SO_2 is the active constituent and suggests the use of melamine and methylbenzimidazole. A great many of the Cibacet, Setacyl, Celliton, and Arisil dyes are not sensitive to illuminating gas.

Estimation of Dyestuff

The estimation of dyestuff in solution and on the fiber. E. Waters. *J. Soc. Dyers and Colourists* **60**, 200–5 (Aug. 1944).

Because dyestuffs cover such a diverse field of organic chemistry the ideal method of quantitative analysis is not chemical but optical, i.e., the color of dye solution is used to estimate the quantity of dye present. The theory and use of absorptiometers for this purpose is discussed; instruments included are the Dubosqu colorimeter, the Leitz Absolute Colorimeter, the Hilger Spekker absorptiometer, the spectrophotometer, and the Donaldson

or Guild type of trichromatic colorimeter. The quantitative estimation of dye on the fiber is difficult but may be carried out with a colorimeter or spectrophotometer (fitted for reflectance measurements) by comparison of the data obtained with a graph prepared from dyeings of known depth and composition of shade. The usual method of estimation of dye on the fiber however involves extracting the dye, or dissolving both fiber and dye and estimating the dye in solution colorimetrically. Possible methods of dissolving the various types of dyes are discussed.

Dyeing Nylon

The application and fastness properties of dyes on nylon. J. G. Grundy. *J. Soc. Dyers and Colourists* **60**, 205–10 (Aug. 1944).

The chemical and physical properties of nylon, especially as related to the dyeing process, are reviewed. Nylon is shown to lose considerable strength and elongation on prolonged exposure to the Fadeometer are —over 75% strength is lost after exposure for 275 hours. The suitability for nylon of dyes of all the major classes are considered in some detail, with particular reference to their fastness properties toward such agencies as light, stoving, gas fumes, washing and perspiration. In the case of acid, Neolan, chrome and direct dyestuffs, selected dyes are listed according to their suitability for dyeing nylon. It is noted that defects in dyeing nylon may arise due to uneven cold drawing of the nylon during manufacture; dispersed acetate dyes cover such faults whereas other classes of dyes are less satisfactory in this respect. In general, acetate dyes are the best levelling, and can be used for heavy shades; many acid, Cloth Fast and Neolan colors have better fastness but do not give full shades; some chrome fast dyes give both excellent fastness and heavy shades; directs, sulfurs and azoics have little affinity for nylon; vat dyes are markedly lacking in fastness on nylon.

Wool Dyeing

Faults in wool dyeing, their avoidance and correction. F. Townend. *Am. Dyestuff Reptr.* **33**, 327–31 (July 31, 1944). Reprinted from *J. Soc. Dyers and Colourists* **60** (June, 1944).

The effects on the dyeing properties of the wool fibers of carbonizing, peroxide bleaching and sulfur stoving on the one hand, and alkali damage, setting processes, antishrink processes and mildew, on the other hand, are discussed and co-ordinated. Methods of correcting material which is unevenly dyed due to improper control of these processes, and the precautions to be taken to tighten up the control, are described.

Indigo Dyeing on Wool

Indigo and indigo dyeing on wool. Oscar Leupin and B. Hartmark. *Melliand. Textilber.* **24**, 394–99 (1943); *Chem. Zentr.* 1943, II, 1924 (through *Chem. Abstr.*, 1944, **38**, 6100[9]).

The literature assigns to crystalline indigo a molecular weight of 524. The red-violet indigo as a vapor or in certain solvents has a molecular weight of 262. The necessity for different structural formulas for the blue and red violet modifications cannot be proved. Color theory and its relation to indigo are discussed. Fundamentals for the true absorption of indigo on wool in comparison with cotton is considered. By electrometric titration indigo white was shown to be a weak acid. Potentiometrically it can be shown that with increasing halogen content of the indigo derivatives the acidity increases. Only the free vat acids, but not their salts, are oxidizable to the dye. Therefore, the oxidation is hastened by acids and slowed down by NaCl, NaOH and hyposulfate. Wool, whose basic groups have been neutralized with tetrachlorophthalic acid, Wool-reserve CB or naphthalene-monosulfonic acid is more weakly colored with indigo white than normal wool. This shows the acid nature of indigo white; by oxidation to indigo the basic groups again become free and cause more indigo white to combine. The reaction of the color changes for indigo on wool proceeds from Na indigo white through indigo white acid and the indigo white wool salt to indigo white and finally indigo.

FIBERS: YARNS: FABRICS: MECHANICAL PROCESSES

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Storage of Cotton

Variation in Cu number, cuprammonium fluidity and fiber strength of cotton stored under high humidity. C. Nanjundayya. *Indian Textile J.* **54**, 309–12 (1944) (through *Chem. Abstr.*, 1944, **38**, 6103[8]).

Samples of raw cotton drawn from the stored bale at intervals of 6 months gave Cu numbers varying within wide limits. Samples taken after the monsoon period gave nearly double the value in comparison with that drawn at the end of the dry period. Experimental data and results of determinations on the properties mentioned are given. Five conclusions are: (1) raw cotton (uncleaned) stored under specified condition undergoes a marked change in Cu number, insignificant increase in fluidity and considerable loss in fiber strength, (2) there is a progressive increase in the moisture content, (3) the high Cu number is mainly due to noncellulosic substances which undergo a continual change under the conditions of storage tried, (4) noncellulosic substances, especially pectins, do not influence the cuprammonium fluidity of cotton and (5) while chemical tendering lowers both strength and viscisity, microbiological tendering has little effect on the latter but adverse effects on the former.

Carding and Spinning

Probable trends in carding and spinning. Part I. Robert M. Jones. *Textile Bulletin* **67**, 28–32 (Oct. 1, 1944). **Part II.** R. J. McConnell. *Ibid.* **67**, 32, 44–5 (Oct. 1, 1944).

A brief review of recent developments in machinery and processing. Some results of research on the development of machinery to handle the different types of fiber are given.

South Carolina operating executives discuss carding and spinning. Anon. *Textile Bulletin* **67**, 16–24 (Oct. 15, 1944).

Six questions relative to carding and spinning were discussed at the September 16, 1944 meeting of the Southern Textile Association held at Spartanburg, South Carolina. An abstract of the discussion is given. Among the topics dealt with were: division of the work of spinner and clean-up hands; speed of operation of doffer combs; effect of temperature on wear and effect of exhausting the air from pickers into a mote box under each beater.

Fiber Structure

The fine structure and properties of natural and synthetic textile fibers. Kurt Hess. *Melliand Textiber.* **24**, 289–93, 333–37 (1943); *Chem. Zentr.* 1943, II, 1765 (through *Chem. Abstr.*, 1944, **38**, 6101[8]).

A detailed discussion of the fine structure of the cell walls of vegetable fibers, the structure of synthetic cellulose threads, and an explanation of the mechanical properties based on the natural structure of cell walls. A purely molecular, theoretical explanation of fiber strength is rejected. The high strength of completely synthetic fibers may be due to forces between lattice structures.

Flax and Hemp Wastes

A process for the recovery of all spinnable fibers from long flax and tow. Yves Maury. *Ind. Textile* **60**, 153–54 (1943); *Chem. Zentr.* 1943, II, 2223 (through *Chem. Abstr.*, 1944, **38**, 6101[6]).

In order to utilize flax and hemp wastes they were treated at 80–90° with a lye containing, e.g., NaOH 1%, Na_2CO_3 2.5%; Nekal 0.005% and Na_2SO_3 0.5% (as a reducing agent), then acidified with HCl and H_2SO_4, bleached with hypochlorite and washed.

Processing Synthetic Staple

Processing long staple fibers. James Chatfield. *Textile Age* **8**, 64–72 (Oct. 1944).

Experience has shown that the longer synthetic fibers become progressively weaker when subjected to continued processing, and may even break if the overworking is prolonged. For this reason, the use of a single process of roving becomes almost

imperative if the yarn counts required make this possible. To obtain the best results the weight of the sliver must be on the light or moderate side, from 45 to 50 grains for yarns from 60s to 80s; and for the coarser counts, the sliver should not weigh over 55 grains per yard. Fifty grains will be better if the organization can be so worked out. Long draft spinning is required but it is wise not to go over 36, even with the most advanced equipment. It is recommended that the conventional drafting assembly be removed from the roller beam and replaced by one of the units that have been designed especially for this class of stock. A description is given of one of these.

Direct-Fired Heat

Direct-fired heat for textile drying needs. C. A. French. *Textile World* **94**, 113–15 (Oct. 1944).

The use of drying ovens constructed as completely independent units so engineered that the heat may all be generated within the oven and both radiant and sensible (convected heat) be applied directly to the cloth. Infra-red gredient burners are used. Under ideal conditions, the oven atmosphere should consist only of steam (formed from the water in the cloth), nitrogen, and carbon dioxide. The steam, due to the high oven temperatures, becomes superheated and acts as a drying gas. By means of an exhauster, these gases are forced into contact with the cloth. Most of the gases are then recirculated and reheated from a temperature of 210° F to 800° F and again contact the cloth. Since the dew-point in such a drying unit is in the neighborhood of 168° F, it can be seen that there is no danger of re-saturation of the cloth. The high temperatures (in the neighborhood of 800° F) to which the wet cloth is subjected as it enters the dryers removes the water with extreme rapidity. As the cloth passes on through the dryers, it is contacted repeatedly by gases at progressively lower temperatures as its water content is still further reduced. The last few percent of moisture is removed at such a low temperature that the cloth could not be injured even if it were bone-dry. Some advantages cited are: (1) Drying costs reduced by amounts varying from moderate to very substantial, depending upon the available fuel; (2) An improved loft of hand, especially noticeable on twills, pile fabrics, etc.; (3) A decided reduction in shrinkage; (4) Drying gas oxygen-free and inert; (5) A greatly reduced first cost of installation, as compared to steam dryers; (6) Negligible maintenance costs, as these dryers possess only one moving part; (7) Thermal efficiencies of 80 to 90%, as compared to 20 to 50% in conventional steam-heated drying apparatus.

MISCELLANEOUS

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Survey of Cotton Textiles

Ten years of cotton textiles. Anon. *Cotton* **108**, 114–15 (Sept. 1944).

Increasing Government control over the distribution of cotton textiles with much heavier percentages of production directed through systems of graded priorities into specific end-uses not only for war effort but in fields previously reserved for unrated civilian business, were foreseen for the remainder of the war period by W. Ray Bell, president of The Association of Cotton Textile Merchants of New York, in the Association's 13th annual survey of the cotton textile situation.

Dermatitis

Dermatitis from synthetic resins and plastics. Anon. *British Plastics* **16**, 256 (June, 1944).

Recent investigations indicate that cases of dermatitis thought to be due to working with synthetic resins are traceable to deficiencies in the patient's diet. The deficiency appears to be linoleic and linolenic acid. The dermatitis has been made to disappear in one week by the Esoban treatment which makes use of maize oil ointments used externally, or linoleic and linolenic acid capsules internally.

Industrial Lighting

Scientific lighting in the textile industry.

J. W. Howell. *J. Soc. Dyers and Colourists* **60**, 161–9 (July, 1944).

The underlying principles of sight and seeing and the relation between adequate illumination and industrial efficiency are discussed. Detailed analyses are made of scientific lighting in the following textile processes; wool grading and sorting, drawing-in, weaving, cloth inspection, and dyeing. The economic value of improved lighting is illustrated graphically for actual warping and weaving operations, with production and profits plotted against watts per machine. Unidirectional and dispersive lighting are compared. Color correction in light sources, and radiant heating with infra-red lamps are also discussed.

Paper Laminates

Paper laminates. F. W. Griffith. *British Plastics* **16**, 257–59 (June, 1944).

A non-technical discussion of paper-base laminates and their possible future applications. Chief emphasis is given to those made with melamine-formaldehyde resin. The unusually attractive appearance, the fire-resistance, and resistance to weathering of melamine laminates indicate a wider use of them in the post-war period.

Paper-base laminates in aircraft. Charles F. Marschner. *Modern Plastics* **21**, 81–85, 168–70 (Mar. 1944).

A comprehensive review is given of the development work done by McDonnell Aircraft Corporation on the use of paper-base laminates for aircraft construction. This work uncovered several important facts and confirmed certain theories. For example, phenolic resins seem to provide the best inter-fiber bonds, although other resins now being developed appear to be as satisfactory. The lateral displacement of fibers caused by weaving, by twisting the strands, or by combination of these factors makes it impossible to develop the full strength and modulus of the fibers. Reduction of the resin content to a practical minimum provides better mechanical properties by permitting an increase in the number of strength giving fibers. High strength can only be achieved by using a filler of fibrous nature. A 35% resin content appears to be about the practical minimum for paper-base laminates if good compressive strength is to be achieved. For each molding temperature there appears to be an optimum resin content to provide optimum tensile strength. Fibrous mats containing oriented textile fibers promise to result in laminates of exceptional strength at costs somewhat higher than paper but substantially lower than cloth.

Nylon Insulation

Nylon for silk. E. B. Wood. *Bell Labs. Record* **22**, 505–8 (Aug. 1944).

Nylon yarn as a substitute for silk as magnet-wire insulation has been found so satisfactory that the Bell System has adopted it not only as a wartime measure, but as a permanent change.

Chemicals for Rayon

Market analysis; chemicals for rayon and cellulose plastics. George D. Bieber. *Chem. and Met. Eng.* **51**, 97–9 (July, 1944).

The large expansion in the production of rayon and cellulose plastics has created an enormous demand for chemicals. From 1933 to 1943, the total consumption of chemicals almost doubled, viscose rayon, cellophane, and sausage casings utilizing about 78%, acetate rayon and nitrocellulose 10%, and cuprammonium rayon, and cellulose acetate and acetate butyrate plastics the remainder. A market for at least 2 to 3½ lbs. of chemicals is generated for each pound of cellulose products manfactured. Statistical information, partly in the form of tables and graphs, is included.

Rotproofing

The preservation of cordage. A. S. Tweedie and C. H. Bayley. *Am. Dyestuff Reptr.* **33**, 373–4, 378–9 (Aug. 28, 1944).

It has been shown that cordage may be manufactured from cotton yet have physical characteristics required of "hard fiber"

(manila, sisal, etc.) cordage. The relative resistance of cotton and the several bast fibers to the rotting action of micro-organisms has been investigated and an assessment has been made of the value, when used on these fibers, of the copper naphthenate rot proofing treatment as called for in the current Canadian specifications for rot-resistant rope. The fibers chosen for test were manila, sisal, "wartime," North American hemp and cotton, in the form of 3/8 inch 3-ply rope. Treated and untreated samples were subjected to a standard soil burial test. After two weeks burial untreated cotton showed 93% loss in strength as compared with 65% loss for untreated manila. Treated cotton showed only 5% loss as compared with 12% loss for manila. The other fibers ranged between these figures. Copper naphthenate appears to be superior to other copper compounds for rotproofing, probably due to the fact that naphthenic acid itself, as well as the copper, is toxic to micro-organisms.

Shrinkage in Laundering

Shrinkage of rayon fabrics due to laundering pressed under controlled tensions. Alice C. Gaston and Hazel M. Fletcher. *Rayon Text. Mo.* **25**, 57–8 (May, 1944).

No difference was found in shrinkage of continuous filament viscose and acetate rayon fabrics. Viscose spun rayon fabrics shrank much more than the continuous filament fabrics. Tension decreased the shrinkage more in spun rayon than in continuous filament fabrics. All showed greater shrinkage in warp than filling.

Southern Regional Research Laboratory

Physics in the service of southern agriculture. Staff of the Southern Regional Research Laboratory, New Orleans. *J. Applied Phys.* **15**, 629–41 (Sept. 1944).

The organization of the research work at the Southern Regional Research Laboratory of the U. S. Department of Agriculture is described. Some of the research programs in operation are mentioned. In this survey the aim has been to include, with an effort at thoroughness, those methods of observation and measurement employed by this laboratory to which physics has contributed a well-defined and prominent role.

Synthetic Textiles

The case for synthetic textiles. Anon. *Modern Plastics* **22**, 91–7, 184–92 (Sept. 1944).

This is Part I of a discussion of synthetic textiles and their place in the economic structure of the textile industry. Part I covers the synthetic fibers, and Part II, in a later issue, will cover coated fibers, coated fabrics, and fabric finishes.

Process Water

Water in the textile industry. III: by product recovery, Lewis B. Miller. *Cotton* **108**, 107–10 (Sept. 1944).

A discussion of by-product recovery, especially from wool scouring wastes. Suggestions are given for determining whether or not waste waters require treatment before discharge. Previous articles in the series were abstracted in TEXTILE RESEARCH, page 350, Oct. 1944 issue.

Twist

Twist. Anon. *Saco-Lowell Bulletin* **16**, 19–22 (May, 1944).

The familiar formula, $T = C\sqrt{N}$, where T is the turns per inch, N the yarn number and C a constant, is derived in two different ways by graphical reasoning. The derivations, although not rigorous, are interesting and instructive.

Wool on Cotton Machinery

Processing wool with cotton machinery. W. Tabor Robinson. *Textile Bulletin* **67**, 18–20, 46 (Sept. 1, 1944).

A discussion of the technical problems involved and precautions to be taken in processing wool with present equipment of cotton machinery.

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Textile Research Institute, Inc.

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TELEPHONE: LEXINGTON 2-2196

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